REVISED

AQUIFER EXEMPTION REQUEST FOR CLASS V INJECTION WELLS (Authorization No. 5X2700062)

April 2010

Prepared for:

EL PASO WATER UTILITIES
1154 Hawkins Blvd.
El Paso, Texas 79961

LBG-GUYTON ASSOCIATES
Professional Groundwater and Environmental Services
1101 S. Capital of Texas Highway, Suite B-220
Austin, Texas 78746

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REVISED AQUIFER EXEMPTION REQUEST FOR CLASS V INJECTION WELLS

SIGNATURE PAGE

Signature of the Technical Report Supervisor

The revised Aquifer Exemption Application must be signed by the technical report supervisor. The supervisor must be a professional engineer, licensed in the State of Texas, or a geologist. The technical report supervisor must be competent and experienced in the Underground Injection Control and Aquifer Exemption Programs and be thoroughly familiar with the operation or project for which the application is made. Attach a copy of the supervisor's resume.

I, Brad L. Cross, Associate, certify under penalty of law that this document and all the attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluation the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature Brad Cross Date April 13, 2010

STATE OF TEXAS
BRAD L. CROSS
GEOLOGY
No. 1401
LICENSED
PROFESSIONAL GEOSCIENTIST

(Note: Applicant Must Bear Signature and Seal of Notary Public)

SUBSCRIBED AND SWORN to before me by the said Brad Cross

On this 13th day of April, ____.

My commission expires on the 18th day of August, 2012.

JOSEPHINE W. PELLEGRINO
NOTARY PUBLIC STATE OF TEXAS
COMMISSION EXPIRES:
08-18-2012

Josephine W. Pellegrino
Notary Public in and for

Travis County, Texas

Brad L. Cross

Brad Cross has over 25 years of experience in the field of groundwater and surface water hydrology, water resources, environmental assessments, and project management. Through his 15 years experience at the Texas Commission on Environmental Quality and contract work with the U.S. Environmental Protection Agency, Mr. Cross also has a thorough knowledge and extensive experience in regulatory issues associated with both ground and surface water resources as well as waste management. Examples include development of rules, regulations, and guidelines associated with Public Drinking Water, Underground Injection Control, Waste Management, and Nonpoint Source Pollution including extensive knowledge of rules development, public involvement and education, development of structural and non-structural best management practices. He has served as permit writer for the TCEQ in both the Class I and Class V injection well areas and served as program manager for the Class V injection well program. He has also served as Division Chair for the Ground Water Protection Council (previously Underground Injection Practices Council).

Mr. Cross has also served as a consultant to the U. S. Environmental Protection Agency, Washington, D.C. in the development of regulatory guidelines for the 1996 Amendments to the Safe Drinking Water Act. Specifically, he assisted EPA in developing guidelines and goals for states and local communities that would not only meet the Act's requirements but provide for flexibility to reduce costs and maintain the delivery of safe water to the public. He also gained over 15 years experience in the permitting of public water supply sources and facilities, water-resource plans review, environmental site assessments, development of best management practices at the local level, writing of state rules and regulations, and developing and addressing water-rights issues. Specific examples include "Rules and Regulations for Public Water Systems" and include general provisions for surface- and ground-water systems, cessation of construction and operations, water sources, water treatment, water storage, water distribution, minimum water system capacity requirements, and minimum acceptable operating practices for public drinking water systems. Mr. Cross was also extensively involved in plans review and permitting of water-resource projects throughout the state.

Mr. Cross developed and directed Texas' statewide drinking water protection program and provided site-specific technical assistance to over 300 communities throughout the state. He was responsible for developing public education strategies and coordination of local, regional, state, and federal representatives to assure comprehensive program coordination. Mr. Cross, in cooperation with EPA, conducted numerous seminars throughout the country for local communities on how to develop ordinances and other best management practices to control nonpoint sources of contamination. He also managed and provided oversight of a $3.0 million joint funding agreement with the U. S. Geological Survey in the development and implementation of a statewide source water assessment program.

Mr. Cross has extensive experience in conducting pollution liability surveys; corporate risk assessments; loss control surveys; evaluation of regulatory compliance at solid and hazardous waste facilities, refineries, petrochemical plants and transportation operations; contaminant evaluation; hydrogeology; water resources; public education; public policy; and, regulatory permitting. He has a solid knowledge of the Resource Conservation & Recovery Act (RCRA), Comprehensive Environmental Response Compensation & Liability Act (CERCLA or Superfund), Clean Water Act (CWA), Safe Drinking Water Act (SDWA), Clean Air Act, and the Emergency Planning & Community Right To Know Act. Auditing of the facilities requires a comprehensive knowledge of the physical hazards, health hazards, indemnification of risk and inventory, Material Safety Data Sheets, labeling, employee & third party information and training (Hazard Communication and Emergency Procedures), compliance with state and federal regulations, contractor & subcontractor issues, and environmental remediation. Mr. Cross also has extensive experience in public interaction as well as report preparation.

EDUCATION

B.S. in Geology, 1980, from University of Texas at El Paso

State of Texas Professional Geologist, No. 1401

TECHNICAL SOCIETIES

Ground Water Protection Council, Oklahoma City, Oklahoma

The Ground Water Foundation, Lincoln, Nebraska

American Institute of Professional Geologists

American Federation of Mineralogical Societies

SUMMARY OF PROFESSIONAL EXPERIENCE

2007 to present:
Associate with LBG-Guyton Associates, Austin, Texas

2000 to 2006:
Senior Hydrogeologist at LBG-Guyton Associates, Austin, Texas

1985 to 2000:
Manager / Hydrogeologist at Texas Commission on Environmental Quality, Austin, Texas; and Contractor to U.S. Environmental Protection Agency

1981 to 1985:
Exploration and Production Geologist, Gulf Oil Corporation, Midland, Texas

SELECTED PROJECT EXPERIENCE

Injection Well Permitting and Aquifer Exemption
Responsible for the development of five Class V/I injection well applications and associated permits for the City of El Paso's 27.5 mgd brackish water desalination plant. Responsibilities include developing the injection well applications, drilling oversight, and reporting. The permits were successfully secured from the TCEQ in mid-2005 and are the first permitted desalination-related injection wells in the state of Texas. An Aquifer Exemption application is currently being prepared to address injection of concentrate that does not meet state and federal primary drinking water standards.

Public Water Supply Protection Strategies
Developed site-specific drinking water protection strategies for over 300 public water supply systems. The strategies included the evaluation of groundwater and surface water availability, modeling zones of contribution, field identification and inventorying of potential sources of contamination within the zone of contribution, developing protection strategies, and providing technical assistance to stakeholders in implementing best management practices. Representative systems include San Antonio Water System, city of El Paso, city of Houston, city of Amarillo, cities of Bryan/College Station, city of Bay City, city of Grand Prairie, city of Irving, Aquilla WSC, and the city of Marlin.

Developed and directed Texas' state-wide drinking water protection program, the first such comprehensive program in the nation.

Developed Nation's First Regional Protection Program
As program director, developed the nations first regional drinking water protection program for the cities of El Paso and Ciudad Juarez, Chih., Mexico. The U.S. Environmental Protection Agency used this bi-national effort to model other programs across the nation with. Key components included international public coordination, development of hydrogeological settings map, identification and data entry of all regional potential sources of contamination, development of a regional protection strategy, development of contingency plans, and development of bilingual educational materials.

Geologic Field Mapping
Conducted geologic field mapping of over 500 square miles north of Ciudad Chihuahua, Chih., Mexico. This remote region had never previously been mapped. The survey was conducted using plane table and alidade and later served as a base map for several economic geology studies.

Critical Area Delineation
Assisted in the initial program development and delineation of state-wide critical areas (now known as "Priority Groundwater Management Areas").

Public Interaction and Coordination
Was responsible for coordination of local, regional, and state-wide public involvement, interaction, and education of drinking water program. Receiving public input and mediating opposing views was key to the successful implementation of program activities. Bringing opposing views and feeling of local ownership into regional projects was a mandatory component of successful implementation.

SELECTED BIBLIOGRAPHY

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U.S. ENVIRONMENTAL PROTECTION AGENCY

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

INTRODUCTION

Background

The Kay Bailey Hutchison Desalination Plant converts brackish water from the Hueco Bolson to potable water for use by the City of El Paso and Fort Bliss. The Hueco Bolson is a major source of water for the El Paso region including the City of El Paso, Fort Bliss, and Ciudad Juárez, Mexico. This underground water resource contains significant quantities of brackish water that had historically been unused. The desalination plant allows a reduction in withdrawals of fresh water from the Hueco Bolson Aquifer and is a critical component of the water supply portfolio for the El Paso area.

Operation of the plant will be consistent with El Paso Water Utilities' (EPWU) conjunctive use of surface water from the Rio Grande and local groundwater. Specifically, during times of "full" river allocation, groundwater pumpage from the Hueco Bolson and operation of the plant will be minimal. Under "drought" conditions, groundwater from the Hueco Bolson and operation of the plant will be maximized to make up for the shortage of surface water. In addition to drought protection, the plant will be used to provide for growth, meet peak demands, and be used if there is a disruption in other supplies.

The plant treats brackish water drawn from the Hueco Bolson, referred to as "feed" water, using reverse osmosis (RO) technology. RO uses semipermeable membranes to remove dissolved solids (primarily salts) from brackish water, producing fresh water. The result is two water streams: fresh water (called "permeate") and a concentrated brine formed from the salt removed from the brackish feed water (called "concentrate"). Permeate has a very low salinity, is very pure and is mixed with brackish "blend" water, also drawn from the Hueco Bolson, prior

to distribution in the public water supply. The blended water is called "finished" water and complies with federal and state drinking water standards.

The Kay Bailey Hutchison Desalination Plant is capable of producing 27.5 million gallons of fresh water daily (MGD). Concentrate disposal from the plant is currently accomplished through three deep injection wells (authorization is for five wells to be drilled), located approximately 22 miles northeast of the plant (Figure 1). EPWU received authorization from the Texas Commission on Environmental Quality (TCEQ) to construct and operate up to five Class V injection wells completed in the Fusselman Dolomite (Silurian age), the Montoya Dolomite (Ordovician age), and the El Paso Group (also of Ordovician age). The Fusselman-Montoya-El Paso Group is considered an underground source of drinking water (USDW) because the Total Dissolved Solids (TDS) of the natural formation water is below 10,000 mg/L.

The current Class V injection well authorization prohibits injecting water that does not meet primary drinking water standards, even if the formation water exceeds the primary drinking water standard for that particular parameter. Native Fusselman-Montoya-El Paso Group water samples demonstrate that the water quality does not meet national and state primary drinking water standards for arsenic, gross alpha (less Ra and U), nitrite, and radium. In addition, the formation water is brackish with a TDS of over 8,000 mg/L.

Under current operations, the chemical composition of the dilute and non-hazardous desalination concentrate (injectate) has a TDS less than 6,000 mg/L. Thus, the concentrate has an overall higher quality than the native Fusselman-Montoya-El Paso Group water. The only parameters of the concentrate that do not meet primary drinking water standards are arsenic and gross alpha (less Ra and U). As noted above, the native Fusselman-Montoya-El Paso Group formation water contains arsenic and gross alpha that already do not meet primary drinking water standards.

Currently, the concentrate is being diluted in order to meet the requirements of authorization (i.e., arsenic and gross alpha concentrations below primary drinking water standards). While the plant is currently generating only 700 gallons per minute (gpm) of concentrate, EPWU recognizes that as water demand increases over the years, the volume of concentrate will also increase, raising the question of how to address the primary drinking water standard issue.

not clear to me,

The most viable option in dealing with injecting concentrate that does not meet primary drinking water standards for one or more parameters is an "aquifer exemption." The U.S. Environmental Protection Agency (EPA) and TCEQ can jointly approve an aquifer exemption by finding that this use (injecting concentrate) in a USDW aquifer may be more important than or otherwise take precedence over, the use of the aquifer as a potential source of water supply for human consumption.

Aquifer exemptions require modifications to State Underground Injection Control (UIC) Programs, including public notice and participation. The exemptions are granted by TCEQ with concurrence from the EPA in accordance with 40 CFR Parts 144-146, 30 TAC and Chapter 331. The process includes submittal of an application package to TCEQ for review. Once the TCEQ reviews and tentatively approves an aquifer exemption request, the request is sent to EPA for approval.

EPA has developed a document (GWPB Guidance #34) that provides guidance to EPA Regional Offices on the process for approving modifications in delegated UIC Programs, including aquifer exemptions. Due to the lack of a formal application form, EPWU has elected to provide justification for an exemption utilizing the "Aquifer Exemption Summary Sheet" from EPA's "UIC Guidance #34." As stated in UIC Guidance #34, a distinction is drawn between "Substantial" versus "Non-Substantial" Revisions to UIC Programs. As is developed in this application, and consistent with UIC Guidance #34, the requested revision to the Texas UIC Program would be considered "Non-substantial" because (1) the TDS concentration of the proposed exempt aquifer is substantially greater than 3,000 parts per million, and (2) the formation is deep and remote. The authority for approval of a Non-Substantial revision would be delegated to the Regional Administrator.

Owner/Operator

El Paso Water Utilities
Attn: Scott Reinert, P.E., P.G.
1154 Hawkins Blvd.
El Paso, Texas 79925
sreinert@epwu.org
(915) 594-5579

Agent/Consultant

Brad L. Cross, P.G.
LBG-Guyton Associates
1101 S. Capital of Texas Highway, Suite B-220
Austin, Texas 78746
bcross@lbg-guyton.com
(512) 327-9640

Facility Contact Information

Facility Name:	Kay Bailey Hutchison Desalination Plant
Location Description:	Injection well facilities are located approximately twenty-two (22) miles northeast of the Kay Bailey Hutchison Desalination Plant and a few miles south of the McGregor Range Camp.
Facility Contact Person:	Scott Reinert, P.E., P.G. (915) 594-5579

Class V Injection Well Locations

There are five permitted Class V injection wells (three active and two authorized but not drilled) associated with the proposed aquifer exemption. Although permitted as Class V injection wells, the wells were constructed in compliance with the more stringent casing and cementing requirements of Class I injection wells. The locations of the wells are as follows:

elevation?

Injection Well	Status	Location (Lat./Long.)
JDF-1	Active	31° 59' 49" N 106° 06' 25" W
JDF-2	Active	31° 58' 24" N 106° 06' 30" W
JDF-3	Active	31° 59' 15" N 106° 06' 43" W
JDF-4	Authorized But Not Drilled	31° 59' 55" N 106° 07' 45" W
JDF-5	Authorized But Not Drilled	31° 59' 13" N 106° 06' 05" W

Aquifer to be Exempted

Formation Name: Fusselman Dolomite (Silurian-age) and the underlying Montoya Dolomite (Ordovician-age) and El Paso Group (Ordovician-age). (A regional stratigraphic column is included as Figure 6.) The Fusselman-Montoya-El Paso Group will collectively be referred to throughout the remainder of this report as the proposed "exempt aquifer."

Fusselman Dolomite - The Fusselman Dolomite consists of a fractured, medium gray to cream color dolomitic limestone. Electric logs (March 2005 Class V Injection Well Application) indicate that the Fusselman is approximately 590 feet thick in the proposed aquifer exemption area.

Montoya Dolomite - The Montoya Dolomite is composed of three members including the Cutter, Aleman, and Upham. The Montoya is characterized by massive beds of dolomite alternating with beds of cherts. Electric logs indicate that the Montoya is approximately 300 feet thick in the proposed aquifer exemption area.

El Paso Group - The El Paso Group consists of a series of medium to dark gray limestones and dolomites. The thickness of the entire El Paso Group in the area of the proposed aquifer exemption is undetermined. Measured thickness of the type section of the El Paso Group in the Franklin Mountains (El Paso) is 1,590 feet. The uppermost 600 feet of the group has been penetrated by the Injection Well No. 1 (JDF-1). In addition to the entire thickness of the Fusselman and Montoya Dolomites, the proposed exemption is for the entire thickness of the El Paso Group rather than the depth of penetration of JDF-1. (Injection Well No. 2 [JDF-2] did not penetrate the El Paso Group and Injection Well No. 3 [JDF-3] penetrated 125 feet of the El Paso Group.)

Penetration into the formations requested for exemption varies in each of the 3 wells

Subsurface Depth: Electric logs indicate the top of the proposed exempt aquifer ranges in depth from 2,222 to 2,890 feet below ground level (BGL).

Vertical Confinement: The upper confining zone for the proposed exempt aquifer consists of over 1,700 feet of continuous low-permeability shale and limestone. These units range in age from Devonian (Canutillo Formation) to Permian (Hueco Group). Confining strata beneath the lowermost interval is the Bliss Sandstone. The Bliss Sandstone (Lower Ordovician) is approximately 250 feet thick and consists of sandstone, quartzite, and siltstone. The quartzite and sandstone are composed of fine to medium quartz grains cemented by clay and silica, providing a low permeability stratum which prevents downward movement of injected fluids.

Aquifer Thickness: The proposed exempt aquifer has a thickness of approximately 2,480 feet. (The Fusselman Dolomite has a thickness of 590 feet, the Montoya Dolomite has a thickness of 300 feet, and the El Paso Group has a thickness of 1,590 feet.)

Exemption Description

The limits of the requested exempt aquifer are defined vertically as the top of the Fusselman Dolomite to the base of the El Paso Group. The upper vertical limit of the exemption ranges in depth from 2,222 to 2,890 feet BGL. At the injection site, the upper confining zone for the proposed exempt aquifer consists of more than 1,700 feet of interbedded Devonian, Mississippian, Pennsylvanian, and Permian shales and limestones. This sufficient vertical

upper confining layer

confinement is maintained throughout the proposed exemption area. Areas of less confinement are recognized outside of the proposed area of exemption.

The lower limit of the requested exempt aquifer is the base of the El Paso Group at depths ranging from 4,702 to 5,370 feet BGL. The confining stratum beneath the lowermost injection interval is the Bliss Sandstone. The Bliss Sandstone is approximately 250 feet thick and consists of sandstone, quartzite, and siltstone. The sandstone and quartzite are composed of fine to medium quartz grains cemented by clay and silica, providing a low permeability stratum which prevents downward movement of injected fluids.

The horizontal limit of the proposed exempt aquifer is defined by the lateral extent of the injectate plume and represents a concentration reduction factor of 1,000 times from the original injectate. The delineation is based on a constant injection of 3 million gallons per day (MGD) over a 50-year injection period. The plume is approximately elliptical in shape with the width of the plume varying from 0.5 to 2 miles and with a length of 17 miles. The total area included in the proposed exemption is approximately 25.5 square miles and is located in El Paso County, Texas (Figure 1).

It is clear from geologic, gravity, and magnetic data that the aquifer is laterally extensive and correlative across the Area of Review. A map showing the proposed exempt area is included as Figure 2.

Justification for Exemption

Aquifer exemptions may be granted under EPA 40 CFR §146.4 and TCEQ 30 TAC 331.13, if:

(X) Aquifer is not a source of drinking water and will not serve as a source of drinking water in the future because it:

(X) Has a TDS level above 3,000 mg/L and less than 10,000 mg/L and is not reasonably expected to supply a public water system

( ) Is producing or capable to produce hydrocarbon

( ) Is producing or capable to produce minerals

this supports 146.4(b)

→ (X) Is too deep or too remote which makes recovery of water for drinking water purposes economically or technically impractical

( ) Is above Class III area subject to subsidence

( ) Is too contaminated

EPWU respectfully requests an aquifer exemption because the formation meets the following criteria:

1. *40 CFR §146.4 Criteria for Exempted Aquifers*

"An aquifer or a portion thereof which meets the criteria for an 'underground source of drinking water' may be determined under 40 CFR 144.8 to be an 'exempted aquifer' if it meets the following criteria:

(a) It does not currently serve as a source for drinking water;

No drinking water wells from proposed exempt aquifer in TX or NM

There are no drinking water wells, public or private, producing water from the proposed exempt aquifer. A search of State public water supply databases (TCEQ Public Drinking Water Section and NMED Drinking Water Bureau) has revealed that there are no public water supply systems utilizing the aquifer as a source of drinking water in Texas or New Mexico.

A search of water well records (drillers' logs), public sources of data, and an on-the-ground site survey in the area indicates that the aquifer has not been nor is currently utilized as a domestic, agriculture, or industrial supply of water. Furthermore, the aquifer is an oil producing formation in West Texas and Southern New Mexico and is also used as an injection zone for disposal of oilfield brine.

2. *§146.4(b)(2) It cannot now and will not serve as a source of drinking water because: It is situated at a depth or location which makes recovery of the water for drinking water purposes economically or technologically impractical.*

The depth of the proposed exempt aquifer ranges from 2,222 to 2,890 feet. Use of the aquifer as a water resource is economically and technically impractical. Water from the proposed exempt aquifer would require treatment before use as a water resource even if injection

of concentrate were not occurring. Brine concentrate would be generated during the treatment process which require disposal.

Alternative sources of drinking water (Rio Grande, Hueco Bolson, Mesilla Bolson, Capitan Reef Aquifer, Antelope Valley, Wildhorse Ranch, and Dell City) are available. These alternative sources have a higher quality and can be produced at a significantly lower cost.

Additional detail on the economic analysis is provided in the "Economic Evaluation of Alternative Water Supply Sources" section of this application.

Oil or Mineral Production History

There is no oil or mineral production history associated with the proposed exempt aquifer in the El Paso area. However, the aquifer is an oil-producing formation elsewhere in West Texas and Southeast New Mexico (Figure 3) and is also used as an injection zone for disposal of oilfield brine.

Active Injection Wells Injecting into Same Formation

Other than the three existing and two authorized/proposed EPWU Class V injection wells associated with the desalination facility, there are no injection wells completed in the proposed exempt aquifer.

Water Use in Area

The proposed exempt aquifer does not serve as a source of drinking water and there are no water supply wells that penetrate the aquifer in this area. To evaluate the production and use of groundwater from the aquifer, an on-the-ground site survey as well as a literature review and file search of the Texas Water Development Board (TWDB), TCEQ, Railroad Commission of Texas (RCC), New Mexico Environment Department (NMED), and New Mexico Energy, Minerals, and Natural Resources Department (NMEMNRD) was conducted to support the permit application.

What about the other APs?

In accordance with EPA UIC Guidance #34, the proposed exempt area and a buffer zone of ¼-mile outside the exempt area was surveyed to identify any artificial penetrations (public water supply wells, domestic water wells, industrial water wells, agricultural water wells, injection wells, oil and gas wells, test holes, exploratory holes, abandoned wells, etc.). The search revealed that there are no water supply wells that penetrate the proposed exempt aquifer.

Twenty-four (24) artificial penetrations were identified in the search; however, the artificial penetrations are relatively shallow, do not penetrate the aquifer or confining zone, and no corrective action is necessary. Thirteen narrow-diameter test holes (GT-1 through 12 and 14) were drilled in 1980 as part of a study to measure temperature gradients in the local area. Eleven of the holes are only 164 feet deep. Of the other two, Well GT-11 penetrated only a few feet into the confining zone, while Well GT-12 penetrated approximately 550 feet into the confining zone. All 13 wells were abandoned and attempts to locate them were unsuccessful. Because of the small diameter of these test holes and the length of time since their abandonment (30 years), it is reasonable to assume that these penetrations have sealed over time and are not causes for concern. Only two of the test holes (GT-6 and GT-12) are located within the Area of Review.

During the exploration and development phase of Kay Bailey Hutchison Desalination Plant design, the US Army Corps of Engineers (COE) drilled four test holes in the area to collect data that was used in evaluating the suitability of the site for injection wells. Only COE test holes TH-1 and TH-3 and the EPWU injection wells penetrate the injection zone. A tabulation of data on all artificial penetrations in the Area of Review is provided as Table 1. Artificial penetrations in Table 1 are identified with map identification numbers that are keyed to the topographic map (Figure 4). Well records available from various state agencies are provided in Appendix E.

State Agency Coordination

As part of the original application process for the authorization of the Class V injection wells and the current aquifer exemption request, coordination meetings were held with staff of the TCEQ, NMED, and EPA. The purpose of these meetings was to inform agency staff of current project status and to receive input on how to best address injecting water that does not

meet primary drinking water standards even if the formation water is already above the primary standards for a particular parameter. A timeline summarizing coordination meetings as well as other project activities is included as Appendix A.

original submission to NM

It was originally thought that a small portion of the area of exemption would extend into the State of New Mexico (Fort Bliss property) and an aquifer exemption application package was submitted to NMED. However, based on refined modeling, the plume will not migrate into New Mexico and a request for withdrawal of the original application will be submitted to NMED.

EXEMPT AQUIFER DESCRIPTION

Stratigraphy

Figure 5 is a geologic map of the area and Figure 6 is a regional stratigraphic column showing the geologic and hydrologic units in the area. The proposed aquifer exemption is located in the southeastern Basin and Range province, defined by topographically high mountain ranges and plateaus separated by adjacent down-faulted basins (bolsons). Geologic units in the area range from Precambrian to Recent. Precambrian, Paleozoic, and Tertiary igneous strata primarily outcrop in mountainous areas, Cretaceous and Permian strata outcrop in plateaus, and Tertiary and Quaternary strata are found in the bolson areas.

The oldest outcropping unit in the El Paso area is the Precambrian *Castner Formation* that was deposited as a marine offshore siliceous and carbonate mud. These sediments were lithified into alternating strata of limestones, siltstones, and shales which were later metamorphosed into marbles and hornfels. The Castner is exposed in a number of places along the eastern slopes of the Franklin Mountains (23 miles west of the proposed aquifer exemption area) and is about 1,112 feet thick. Exposures of the Castner are limited due to burial by younger unconsolidated sediments and by granitic intrusions.

Overlying the Castner Formation is a thin submarine basalt flow known as the *Mundy Breccia*. The Mundy is, in turn, overlain by a thick sequence of quartz sands that have been metamorphosed to the *Lanoria Quartzite*. The Lanoria Quartzite has similar features to those seen in modern beach systems such as the Texas Gulf Coast. A section about 2,600 feet thick can be observed in the nearby Franklin Mountains. The capping stratigraphic unit of the Lanoria is a 1,100-foot thick series of igneous intrusions. The molten rock intruded into the Castner, Mundy, and Lanoria Formations and on occasion some of the magma breached the surface to initiate a series of volcanic eruptions. These eruptions included pyroclastic ash-flow tuffs as well as numerous lava flows.

A quiet period followed and erosion of the igneous rocks began. The erosion continued until about 500 million years ago when a rising sea level gradually flooded the El Paso-Juárez region. Marine sediments that were deposited over the erosional surface were a sandy material that was lithified to form the lower Ordovician-age *Bliss Sandstone*. For the next 250 million

years, the area was part of the continental shelf, a low-lying region very close to sea level that was often inundated by the sea.

Equatorial to tropical marine carbonates (limestones and dolomites) of the *El Paso Group* (Lower Ordovician) were deposited and are exposed along the east flank of the Franklin Mountains. The El Paso Group is overlain by the Upper Ordovician *Montoya Dolomite*. The formation is divided into three members (Cutter, Aleman, and Upham) and is characterized by massive beds of medium to dark gray dolomite alternating with beds of chert.

The overlying Silurian *Fusselman Dolomite* is a massive, magnesium-rich, white to gray, sugary dolomite that is approximately 640 feet thick at its type section in the Franklin Mountains and 590 feet thick in the proposed aquifer exemption area. The Fusselman is an oil-producing formation elsewhere in West Texas and Southern New Mexico and is also used as an injection zone for disposal of oilfield brine.

Overlying the Fusselman is the *Canutillo Formation* (Middle Devonian) which is unconformably separated from the overlying *Percha Shale* (Upper Devonian). The Canutillo Formation is a dark color shale containing a dense basal limestone. Approximately 175 feet of the Canutillo Formation can be found at the type locality in the Franklin Mountains and 155 feet of correlative beds in the Hueco Mountains (east of the proposed aquifer exemption). The overlying Percha Shale is 99 feet thick in the Franklin Mountains and 100 feet thick in the Hueco Mountains. It is a black, non-fossiliferous shale with local green shale lenses.

The Middle to Upper Mississippian *Las Cruces Limestone, Rancheria Formation, and Helms Shale* overlie the Devonian units. The Las Cruces Limestone consists of hard, dense, black limestone beds. The Rancheria Formation is a sequence of cherty, black, bituminous, argillaceous limestone beds that unconformably rests on the Las Cruces. The uppermost Helms Shale is characterized by shale units with minor carbonate units in the upper part.

The Pennsylvanian *Magdalena Group* overlies the Mississippian Helms Shale and is primarily composed of cliff-forming carbonates, shales, and siltstones in the nearby Franklin Mountains. Thick marine carbonates of the *Hueco Group* overlie the Magdalena Group. This Permian-age section has an upper, middle, and lower member and contains over 2,300 feet of light to dark gray limestone and shale.

At the end of the Paleozoic Era, the area was uplifted and occupied this position for most of the Mesozoic Era. During the Cretaceous, the El Paso area was near the head of an arm of the Chihuahuan Embayment, where shallow marine sediments were once again locally deposited. The Cretaceous is present in minor amounts in the Franklin Mountains, underlying the Hueco Bolson, and the Hueco Mountains (400 feet thick). Regionally, the Cretaceous is over 3,000 feet in the nearby Sierra de Juárez and Cerro Cristo Rey (both to the southwest of the project area in Mexico).

The Cenozoic Era was a time of major change in this region. Mountain building forces were in action some 45 to 50 million years ago when bodies of molten magma moved into the crust. None broke through the surface but rather cooled in the crust and are seen today as various plutons throughout the area. Shortly before emplacement occurred, compressive force developed to the southwest and as a result, great masses of Cretaceous limestone were thrust from the southwest to the northeast, forming the Sierra de Juárez.

In time, mountain-building forces waned and the region was geologically quiet until about 29 million years ago when a new system of stresses began. Major geologic features in the area formed in response to the Rio Grande rift, a fault bounded structural feature with uplifted blocks on the east/southeast and west/southwest. The rift begins near Leadville, Colorado and extends southerly through New Mexico to El Paso and then on into Mexico where it appears to die out. A product of the rifting includes the Hueco Bolson, the Hueco Mountains (to the east), the Franklin Mountains (to the west), and the Mesilla Bolson (to the west). Basin fill was derived from erosion of rocks from flanking highlands, the ancestral Rio Grande, and desert sand blown into the area from the southwest.

Hueco Bolson sediments are divisible into the *Fort Hancock Formation* and overlying *Camp Rice Formation*. The Fort Hancock Formation is a lacustrine-type deposit consisting of clays and silts in the south and east regions of the Hueco Bolson. The Camp Rice Formation consists of fluvial deposits of variable sized sands and silts located in the western Hueco Bolson.

The bolson deposits consist of alternating beds of clay, silt, sand, and gravel. The individual beds have a non-uniform character and range in thickness from inches up to about 100 feet. Because of the lenticular nature of the strata, it is difficult to correlate individual beds, even over relatively short distances. Although no wells have penetrated the entire thickness of the

bolson in its westerly extent, recent seismic studies suggest that the maximum thickness of the bolson fill, which occurs within a deep structural trough paralleling the east side of the Franklin Mountains, is about 10,000 feet (Ruiz, 2004). Bolson thickness and sediment grain size generally decrease in an easterly direction across the basin. This corresponds to the change from Camp Rice (fluvial) to Fort Hancock (lacustrine) deposits.

Structural Geology

Digital Elevation Models (DEMs), aerial photographs, along with geologic, gravity, and magnetic data provided the building blocks to interpret the geologic structures at the proposed aquifer exemption site. Four geothermal exploratory slimholes drilled on the Meyer Range, approximately three to five miles northwest of the injection site, also provided information on the stratigraphy and structure of the area. Four slimholes were drilled and cored in 1996 and 1997 to evaluate a potential geothermal source of power generation in this area with a secondary objective of assessing the potential for direct use applications such as space heating or water desalination.

After evaluation of the available data, the Army Corps of Engineers (COE) drilled four test holes in 2003 at the injection site. EPWU also constructed one Class V injection well in 2004 and two Class V injection wells in 2006. These test holes and injection wells provided additional information on the lithology, porosity and permeability, groundwater geochemistry, and geologic characteristics of the area.

The University of Texas at El Paso, Department of Geological Sciences conducted a gravity survey in the area. Six geologic cross-sections (Bouguer Profiles) of the area were generated from a Bouguer Anomaly Map (Granillo, 2004) and are included as Figures 7, 8 and 9. Gravity anomaly maps depict the difference between theoretical computed gravity values and observed gravity values for a region of the earth's crust. Using isolines (lines of equal value) representing gravity (isogals), the gravity contours are overlaid on bedrock geology base maps, providing an interpretation of the regional subsurface geology. During construction of the gravity profiles (cross-sections) for the area, the gravity data was tied to EPWU injection well test hole data to assure quality interpretation of the subsurface.

A geologic structure map on top of the Fusselman has also been constructed. The structure map is based on data from the Class V injection wells as well as five cross-sections from Hawley (2007) and four cross-sections from King (1945). A regional west-east cross-section from the West Texas Geological Survey has also been included. These cross-sections were then used for the development of the Fusselman structure map and also incorporated into the numerical model. The cross-sections are included as Figures 10 through 16 and the structure map with cross-section locations is included as Figure 17.

The geologic framework of the El Paso area, which lies within the Basin and Range Province, is primarily controlled by the Rio Grande Rift which results in a series of grabens, or down-dropped basins. The Late Cenozoic basin and range faulting of the region probably initiated about Late Miocene (29 million years ago).

The bounding faults of the Franklin Mountains, located to the west of the proposed aquifer exemption, indicate a downward displacement of 10,000 feet on either side of the range. Displacements on faults that bound the Diablo Plateau, located east of the proposed aquifer exemption, form an escarpment of more than 400 feet.

Basins in the region formed by normal block faulting include the Hueco Basin and its northern extension, the Tularosa Basin, as well as the Mesilla Basin (located west of the Franklin Mountains and some 30 miles west of the proposed aquifer exemption). These block-faulted grabens are asymmetrical due to downward displacement being greater on one side of the basin than the other.

Hydrogeology

Injection wells associated with the proposed aquifer exemption encountered no groundwater of measurable quantity in the upper 453 feet of alluvial fill, and only occasional minor amounts of groundwater were observed in widely separated thin lenses of bedrock at the injection site. This is due to the wells being located in a transitional area known as the McGregor wedge. Geologically, this wedge is a Mesozoic-Paleozoic platform that forms the east rim of the Hueco basin and the western margin of the Hueco Mountains. Erosion and

very little GW observed below 453'

weathering from the Hueco Mountains have provided the alluvial fill that is present at the injection site.

The principal sources of groundwater within the region are the Hueco Bolson aquifer, the Mesilla Bolson aquifer, and the Rio Grande Alluvium aquifer (all located to the west and south of the injection site).

GW not reached until the proposed exempted aquifers but they are pressurized to 500' BGL

Underground Sources of Drinking Water (USDW)

Groundwater of measurable quantity is not encountered at the injection site until the proposed exempt aquifer is reached at depths ranging from 2,222 to 2,890 feet. The proposed exempt aquifer is under artesian pressure and rose to a height of approximately 500 feet BGL in the injection wells. Sample analyses of the aquifer are included in Table 2. The water quality does not meet national and state primary drinking water standards for arsenic, gross alpha (less Ra and U), nitrite, and radium. In addition, the formation water is brackish with TDS of over 8,000 mg/L.

Upper and Lower Confining Zones

The upper confining zone for the proposed exempt aquifer consists of more than 1,700 feet of interbedded Devonian, Mississippian, Pennsylvanian, and Permian shales and limestones. As shown on electric logs (Class V Injection Well Application), the top of the confining zone is at a depth of 453 feet BGL with the base at depths ranging from 2,222 to 2,890 feet BGL. The confining zone provides extremely low permeability strata that prevent upward movement of injected fluids. This sufficient vertical confinement is maintained throughout the proposed exemption area. Areas of less confinement are recognized outside of the proposed area of exemption. The relative position of the upper and lower confining zones are depicted as Post-Fusselman and Pre-Fusselman on the gravity profiles (Figures 7 through 9) and on geologic cross-sections (Figures 10 through 16).

Core data for the confining zone were not available. However, lithology logs were prepared during the drilling and completion of the EPWU injection wells and the entire confining

unit is well described. Analysis of 32 feet of core extracted from the Percha Shale unit of the confining zone indicates that the hydraulic conductivity within this zone is 2.7E-6 feet/day. (A copy of the complete analyses can be found in Appendix V.B.3(b)-1 of Class V Injection Well Application.)

Additionally, analysis, processing and interpretation of the Fullbore Formation Imager log were performed by Schlumberger Oilfield Services on injection wells JDF-1, JDF-2, and JDF-3. Work included image porosity analysis, fracture identification and classification, and specifically, identifying vertical fluid barriers above 2,314 feet. Analysis indicates that a good barrier is present from 2,071 feet to 2,094 feet; a very good barrier from 2,046 feet to 2,071 feet; a fair barrier from 1,921 feet to 2,046 feet; and a weak barrier from 1,799 feet to 1,921 feet. (All of the barrier depth intervals are measured from Kelly Bushing.) A description of the Schlumberger analysis is included in Appendix V.B.3(b)-2 of the Class V Injection Well Application.

The confining stratum beneath the lowermost injection interval is the Bliss Sandstone. The Bliss Sandstone is approximately 250 feet thick and consists of sandstone, quartzite, and siltstone. The sandstone and quartzite are composed of fine to medium quartz grains cemented by clay and silica, providing a low permeability stratum which prevents downward movement of injected fluids.

Aquifer Thickness

The proposed exempt aquifer is approximately 2,480 feet thick (The Fusselman is 590 feet thick, the Montoya is 300 feet thick, and the El Paso Group is 1,590 feet thick).

Injection Interval

The injection intervals in the EPWU injection wells were determined from both core analysis and a differential temperature survey. The top of the injection interval is the top of the Fusselman Formation and the base of the injection interval is the base of the El Paso Group.

Groundwater Flow

Static water level data in the injection wells supports a south to southwesterly flow direction (EPA, 1997). Groundwater movement to the south can also be interpreted by temperature gradient studies performed by Taylor (1981) and Witcher (1997). Groundwater flow in the Hueco Bolson and Diablo Plateau generally follows the elevation change of the overlying topography. In general, Hueco Bolson groundwater flow in Texas is from north to south toward the Rio Grande, except where it is diverted toward areas of significant municipal pumping. Diablo Plateau groundwater generally moves in a southerly and easterly direction discharging in the Dell Valley/Salt Flats area.

Aquifer Properties

Table 3 provides a compilation of aquifer properties for the proposed exempt aquifer. The proposed exempt aquifer has a thickness of approximately 2,480 feet and consists primarily of dolomitic limestones and alternating beds of chert. Geophysical logs indicate the top of the aquifer ranges from 2,222 to 2,890 feet BGL in the proposed aquifer exemption area. A conventional core recovered from 2,306 feet to 2,315 feet BGL in injection well JDF-1 has porosities ranging from 1.4% to 13.2% with an average porosity of 6.3%. Hydraulic conductivity of the aquifer is 7.02E-04 ft/sec and was determined from aquifer tests involving JDF-1, JDF-2, and JDF-3. Temperature was determined from initial well testing on JDF-1 and range from 155.45°F at 2,315 feet to 161.81°F at 3,765 feet. Density was measured at 1.0052 g/cm^3 in JDF-1. A viscosity value of 0.397 cp was calculated from a fluids property input module in the PanSystem2 analysis software (Van Wingen, 1950). An aquifer static pressure was measured in JDF-1 at 786.82 psia at 2,303 feet.

Aquifer Water Quality

The groundwater quality in the proposed exempt aquifer was sampled in each of the three constructed Class V injection wells and contains water that does not meet primary water quality standards for arsenic, gross alpha (less Ra and U), nitrite, and radium. TDS in injection well JDF-1 was measured at 8,260 mg/L, injection well JDF-2 was measured at 8,640 mg/L, and

injection well JDF-3 was measured at 8,780 mg/L. A summary of the sample analyses for the proposed exempt aquifer is included in Table 2. Complete analyses are included in Appendix B. (A copy of the laboratory analysis for the current non-dilute concentrate is included in Appendix C.)

The arsenic standard was not met in one of the three samples collected (10.6 ug/L *vs.* a standard of 10 ug/L). The Gross Alpha standard was not met in any of the three samples (412, 620, and 774 pCi/L *vs.* a standard of 15 pCi/L). The nitrite standard was not met in one of the samples (1.14 mg/L *vs.* a standard of 1 mg/L). The radium standard (Ra-226+Ra-228) was not met in both samples collected (15 and 19 pCi/L *vs.* a standard of 5 pCi/L).

As indicated above, the aquifer is not utilized as a municipal, domestic, agricultural, or industrial source of water. In the unlikely event that the aquifer was used as a municipal supply, treatment would be required to meet primary drinking water standards. As part of the treatment process, brine concentrate would be generated and would require disposal.

RESERVOIR MODELING

A groundwater flow and transport model was developed to estimate the pressure increase and extent of the non-hazardous injectate front resulting from the injection of concentrate at a rate of 3 MGD for a 50-year period. Actual plant operation is expected to inject concentrate at a rate less than 3 MGD. As discussed in the Introduction of this report, operation of the desalination plant will be consistent with EPWU's conjunctive use of surface water from the Rio Grande and local groundwater. Specifically, during times of "full" river allocation, groundwater pumpage from the Hueco Bolson and operation of the plant will be minimal. Under "drought" conditions, groundwater from the Hueco Bolson and operation of the plant will be maximized to make up for the shortage of surface water. In addition to drought protection, the plant will be used to provide for growth, meet peak demands, and be used if there is a disruption in other supplies. As such, the areal extent of the plume presented in the modeling section is considered a worse case scenario.

The regional hydrogeology, hydrostratigraphic structure and borehole information discussed in previous sections was used as the basis for developing the conceptual model for the reservoir model. Hydraulic conductivity estimates from pumping tests were incorporated into the model and observed water level measurements in the injection wells were used to simulate aquifer flow and help calibrate the flow model. The flow and transport model was then used to estimate the area of exemption by simulating the transport of the injectate over a 50-year period.

Conceptual Model

The conceptual model and structural information for the groundwater flow and transport model was based on the regional hydrogeology and the detailed site-specific hydrogeologic information obtained from investigations of the injection area. The aquifer thickness (2,480 feet) was based on the hydrogeologic assessments near the injection facility and the geologic descriptions and geophysical logs obtained from the injection well boreholes.

The hydraulic properties in the model were based on analytical results from pressure tests performed in the injection zone. The table below summarizes the results of the pumping tests in the injection wells. Well tests were completed in JDF-2 and JDF-3 and water level

measurements were collected in other wells. The analysis of the data from each pumping test is described (leftmost column) by the well that the pumping occurred in and the well that was used to monitor the pressure change. The transmissivity and storativity estimates were calculated from two different analytical methods (Jacob and Theis) for each well pair. Because the water is relatively fresh (i.e., low total dissolved solids), the hydraulic conductivity was calculated assuming standard viscosity and density of water. To calculate the hydraulic conductivity, the thickness of the open-hole interval in the wells was assumed to be 600 feet, which is the thickness of the Fusselman. This thickness is less than the entire aquifer zone (2,480 feet). The geometric mean hydraulic conductivity estimated from the pumping tests (shown on the last row of the table) was incorporated into the model. The use of the geometric mean implies that the distribution of hydraulic conductivity in the aquifer is log-normally distributed, and the flow is essentially two-dimensional (de Marsily, 1986).

Well Test	Transmissivity (ft^2/day)	Storativity	Method	Transmissivity (ft^2/sec)	Hydraulic Conductivity (ft/sec)
JDF2_1obs	34,300	1.39E-04	Theis	0.397	6.62E-04
JDF2_1obs	41,600	3.80E-05	Jacob	0.481	8.02E-04
JDF3_1obs	35,700	2.86E-05	Theis	0.413	6.89E-04
JDF3_1obs	29,000	2.90E-05	Jacob	0.336	5.59E-04
JDF3_2obs	30,700	9.50E-06	Theis	0.355	5.92E-04
JDF3_2obs	35,200	3.16E-06	Jacob	0.407	6.79E-04
JDF2_3obs	43,400	1.78E-05	Theis	0.502	8.37E-04
JDF2_3obs	44,400	1.27E-05	Jacob	0.514	8.56E-04
Geometric Mean	**36,392**	**2.04E-05**		**0.421**	**7.02E-04**

The aquifer fluid and the injectate were very similar with respect to concentration of total dissolved solids. For this reason, it was assumed that small variations in fluid density, viscosity and temperature were insignificant in determining the flow and transport of the injectate in the aquifer and therefore not considered in the reservoir modeling. The porosity value in the model was 0.063, which was the estimate from the JDF-1.

Water levels in the three injection wells were measured in March 2007. The measurements were 3,660 feet in JDF-1, 3,616 in JDF-2, and 3,633 in JDF-3. The resulting

How does this square with the ARTESIAN statement on p. 17 if these 3 wells are open to the Fusselman? Because they are providing depths in terms of above sea level

hydraulic gradient was 0.008 foot/foot in the direction 60 degrees west of south. The impact of the local faulting on the local hydraulic gradient is not known, but the northwest-southeast faulting is expected to have some impact on local water levels and flow directions. The hydraulic gradient measured at the site was used in conjunction with the regional flow patterns as a basis for setting boundary conditions on the north and south ends of the flow model. EPA (1997) documents a southerly regional flow direction in the nearby Hueco-Tularosa aquifer but indicates that flow directions near the injection wells are influenced by complex geology. For the purposes of this modeling, it was assumed that regional groundwater flow was to the south in the injection zone as well. While the local hydraulic flow gradient measured at the site (0.008 foot/foot) was considered in developing the flow model, it was determined that this local gradient did not represent regional conditions. This decision was based on two observations. First, the complex nature of the geology and faulting in the area of the wells used to estimate the gradient. Second, the local gradient (0.008 foot/foot) is significantly higher than the hydraulic gradient in the nearby Hueco-Tularosa aquifer. EPA (1997) indicates that the southerly gradient in the shallow aquifer is about 0.0015 foot/foot. Therefore, it was determined that the regional hydraulic gradient in the Fusselman-Montoya-El Paso Group was 0.003 foot/foot.

Model Description

The USGS groundwater flow code MODFLOW-2000 (Hill and others, 2000) was used to simulate pressure response in the injection zone. MODFLOW is a computer program that simulates three-dimensional ground-water flow through a porous medium by using a finite-difference method.

The MT3DMS code (Zheng and Wang, 1999) was used to simulate movement of the transport of the injectate over the 50-year injection periods. MT3DMS is designed for use with any block-centered finite-difference flow model, such as MODFLOW-2000, under the assumption of constant fluid density and full saturation.

MODFLOW-2000 and MT3DMS were selected for the modeling because both codes are well documented and publicly available. Based on aquifer and fluid testing in the injection zone, it can be assumed that fluid density and temperature are relatively constant in the injection zone

and transport domain. In addition, the flow system and boundary conditions are relatively simple and the injectate is assumed to be a non-reactive fluid that does not degrade or adsorb.

Model Development and Calibration

The model grid is shown in Figure 18. The single layer MODFLOW finite-difference grid consisted of 895 rows and 552 columns, for a total of 494,040 cells. The grid was refined in the transport domain with a spacing 200 x 200 feet and the grid spacing was 1,000 x 1,000 feet for all other cells. The grid was oriented parallel to the direction of groundwater flow, which is approximately from the north to the south. The dimension of the model parallel to flow is 280,000 feet (53 miles) by 150,000 feet (28 miles) perpendicular to flow.

The thickness of the single model layer was 2,480 feet. The estimated elevation of the top of the Fusselman-Montoya-El Paso Group was used as the top elevation of the model layer wherever the Fusselman-Montoya-El Paso Group exists. However, as discussed in the structural geology section and shown in Figure 17, the Fusselman-Montoya-El Paso Group is not present in the vicinity of the Hueco Mountains. In the areas where the Fusselman-Montoya-El Paso Group is not present, only lower permeability rocks are present (King, 1945). Therefore, a no-flow zone was incorporated in those areas because it was assumed that no significant groundwater flow occurred in this area due to the uplift and low permeability rocks as shown in Figure 18.

The injection zone was assumed to be a homogeneous and isotropic porous media with a hydraulic conductivity of 7.02E-04 ft/sec, and a porosity of 0.063. The aquifer fluid was assumed to constant temperature and density, and the same as the injectate. These assumptions were based on data that demonstrate that the groundwater quality of the injected concentrate is very similar to the natural formation water in the aquifer (in terms of TDS). The longitudinal and transverse dispersivity were assumed to be 250 and 25 feet, respectively. These values are within the range of estimated dispersivity values reported by Gelhar et.al. (1992) for large, field-scale studies. Table 3 contains a summary of model input values.

The regional hydraulic gradient of 0.003 foot/foot) was implemented in the model domain by specifying head boundaries at northern edge (upgradient) of the model and on the southern edge (downgradient) of the model. The specified head on the upgradient and

downgradient edges of the model were 3,800 feet (amsl) and 2,900 feet (amsl), respectively. These boundary conditions reproduce the observed water level at the site (3,630 feet amsl). The eastern and western edges of the model were considered no-flow boundaries because they are roughly parallel to the regional groundwater flow.

The model was used to simulate steady-state pressure conditions in the injection zone. Figure 19 shows the contours of the pressure head in the aquifer as simulated by the model under steady-state conditions prior to injection. The potentiometric surface indicates that flow from the injection site is south-southwest due in part to the influence of the structural high of the Fusselman-Montoya-El Paso Group associated with Hueco Mountains. The uplift causes the groundwater moving into the model area from the north to flow either to the east or west around the relatively impermeable uplifted section. As discussed above, EPA (1997) documents a similar groundwater flow pattern in the Hueco-Tularosa aquifer.

The model was used to simulate the pressure buildup in the injection zone as a result of a maximum constant rate of 3 MGD for 50 years. However, the actual rate of injection for the concentrate will be based on plant operation that will be governed by the availability of surface water, population growth, meeting peak demands, and any disruption in other supplies. It is anticipated that the actual amounts of injection will be, on the average, less than the constant rate of 3 MGD for 50 years. A steady-state simulation was completed to calculate the pressure increase. A steady-state scenario was simulated because it is considered to be the most conservative estimate as it provides the largest pressure increase and area of influence.

Figure 20 shows the steady-state pressure increase in the aquifer throughout the model area when 3 MGD is injected. The contours of pressure increase are in units of feet of water head. The model indicates that the pressure increase is less than 1.5 feet at distances greater than about a one mile from the injection wells. The pressure increase is relatively small because of the relatively high hydraulic conductivity of the aquifer. The model gridblocks are 200 x 200 feet at the injection wells and therefore the model is not appropriate for simulating well hydraulics or pressure buildup in the wellbore.

Extent of Plume

The extent of the plume was simulated by assuming constant injection at 3 MGD of injectate. The injectate was assumed to have a concentration of 1 mg/L, and the natural formation was assumed to have a concentration of 0 mg/l. Therefore, the model results can be depicted as relative concentration contours. The relative concentration (C/Co) is the calculated model concentration (C) divided by the initial concentration of the injectate. The full strength injectate has a C/Co value of 1.0. As an example, the relative concentration of 0.001 in the aquifer represents a concentration reduction factor of 1,000 times from the original injectate. Thus, the relative concentration can be used to determine the actual concentration of constituents if the injectate concentration is known. Another way to think about the relative concentration is that it represents the fraction (ranging from 0.0 to 1.0) of the original injectate that is present at a given location in the aquifer. Therefore, a relative concentration of 1.0 indicates that the water in the aquifer consists of 100% injectate. A relative concentration of 0.001 indicates that the water in the aquifer consists of 0.1% injectate.

Lateral Extent of Plume

The MT3DMS code was used to simulate the movement of the injectate for 50 years with a constant injection of 3 MGD. The extent of the plume after 10, 30, and 50 years are shown in Figures 21, 22 and 23, respectively. The figures show the migration of the plume throughout the 50-year injection period. Each figure shows the extent of the plume as represented by the relative concentration contours of 0.5, 0.1, 0.01 and 0.001. The relative concentrations are small because of the high volume of aquifer water that moves through the aquifer, resulting in a significant dilution and dispersion of the injectate in the aquifer. Because of the high dilution and dispersion, the role of molecular diffusion over the 50-year injection period is considered insignificant. Figure 23 shows that the proposed exempt area is consistent with the 0.001 relative concentration contour after 50 years.

To calculate the area of aquifer to exempt, a ¼ –mile buffer was added to the extent of the injectate plume after 50 years as defined by the 0.001 relative concentration contour. A 50-

So the way this model for dilution & dispersion is proposed they are saying No matter what the contaminant is, its original concentration should be 1/1000th of its original concentration at the boundaries depicted in the 50 year plume, (figure 23)

year projection for the injectate is included in Table 2. The proposed exempt area of the aquifer is shown in Figure 2.

Assessment of Vertical Plume Movement

Not missing in Aus 2010 version

Figure 24 schematically illustrates the vertical cross-section near the injection facility. As shown in the figure, there is approximately 1,700 feet of confining shale and limestone above the injection zone. Vertical migration of injectate was modeled through the confining units by calculating a conservative advective velocity through the overlying units based on the pressure increase during injection. The pressure increase was estimated by calculating the maximum pressure increase near the injection facility as simulated in the model. The model indicates that the maximum pressure increase occurred in the 200 by 200 ft model cell containing JDF-3, which is in the center of the injection area. The pressure increase at the top of the injection zone is 2.25 feet after 50 years. Based on the data shown in Figure 19, an area of about 17,088 acres experiences 1.0 foot or more of head increase.

To estimate the average vertical linear velocity through the overlying confining zone, Darcy's Law of flow through porous media was used. Darcy's Law is stated as:

$$q_s = -K\frac{dh}{dl}\frac{1}{n}$$

where:

q_s = vertical average linear velocity through confining zone (length/time)

dh = head difference across the confining zone (length)

dl = thickness of the confining zone (length)

n = effective porosity of the confining zone (-)

K = vertical hydraulic conductivity of the overlying units (length/time)

To calculate the volume of water per unit area moving upward into the confining zone (q), the vertical average linear velocity through confining zone (q_s) is multiplied by the effective porosity of the confining zone (n) as:

$$q = q_s \cdot n$$

The vertical hydraulic conductivity of the confining zone was based on the analysis of five feet of core extracted from the Percha Shale unit of the confining zone. Measured vertical hydraulic conductivity within the Percha Shale is 2.7E-6 ft/day. Assuming there is no vertical hydraulic gradient in the overlying units, the head difference across the 1,700 feet thick confining zone due to the pressure increase during injection is 2.25 feet. Assuming an effective porosity of 0.10, the vertical average linear velocity through the confining zone is calculated:

$$q_s = 2.7 \times 10^{-6}\ ft/day \cdot \frac{2.25\ ft}{1700\ ft} \cdot \frac{1}{0.10}$$

$$q_s = 3.6 \times 10^{-8}\ ft/day$$

Therefore, over the 50-year injection period, the upward vertical movement of the injected water through the overlying confining unit is:

$$3.6 \times 10^{-8}\ ft/day \cdot \frac{365.25\ day}{1\ yr} \cdot 50\ yr = 6.5 \times 10^{-4}\ feet$$

The volume of injected water per unit area moving upward into the confining zone (q), is calculated as:

$$q = q_s \cdot n = 3.6 \times 10^{-8}\ ft/day \cdot 0.10 = 3.6 \times 10^{-9}\ ft/day$$

Making the conservative assumption that the increased pressure of 2.25 feet occurs over the entire 17,088 acres that experiences at least one foot of head increase, the volume of water moving into the confining zone through the 17,088 acres over the 50-year injection period is calculated as:

$$3.6 \times 10^{-9}\ ft/day \cdot \frac{365.25\ day}{1\ yr} \cdot 50\ yr \cdot 17088\ acre = 1.1\ acre-feet$$

Assuming that 3 MGD is constantly injected for 50 years, the total volume of water injected at the facility is calculated as:

$$3 \times 10^{6}\ gal/day \cdot \frac{365.25\ day}{1\ yr} \cdot 50\ yr \cdot \frac{acre-feet}{325851\ gal} = 168137\ acre-feet$$

Therefore, the percentage of the injected water that moves upward into the confining zone during the 50-year injection period can be calculated as:

$$\frac{1.1\ acre-feet}{168137\ acre-feet} \cdot 100\% = 6.5x10^{-4}\ \%$$

ECONOMIC EVALUATION OF ALTERNATIVE WATER SUPPLY SOURCES

The proposed exempt aquifer is not a source of drinking water and will not serve as a source of drinking water in the future because it is situated at a depth and location which makes recovery of water for drinking water purposes economically and technically impractical. As previously discussed, the chemical characteristics of the aquifer would necessitate treatment prior to distribution as publicly-supplied drinking water. In addition to having a TDS level above 8,000 mg/L, the aquifer does not meet primary water quality standards for arsenic, gross alpha (less Ra and U), nitrite, and radium, making the use of groundwater from the aquifer impractical for human consumption.

Dr. Anthony Tarquin, Professor of Civil Engineering/Science Engineering at the University of Texas at El Paso, has conducted extensive research at the Center for Inland Desalination Systems on the use of membrane technology in the desalting of brackish water and wastewater. Due to the naturally occurring salinity levels in the Fusselman-Montoya-El Paso Group, Dr. Tarquin has concluded that in order for the groundwater to be used as a future source of drinking water, it would have to be subjected to rigorous treatment to remove the contaminants that are currently present. Dr. Tarquin has concluded that the injection of the concentrate would not render the groundwater either less treatable or more costly to treat than it already is. Dr. Tarquin's evaluation is included as Appendix F.

Despite the treatability of the water, the energy cost to pump from over 2,222 to 2,890 feet coupled with the disposal of brine concentrate from the treatment process make production of the proposed exempt aquifer economically impractical to render that water fit for human consumption. Production cost from the proposed exempt aquifer is estimated to be approximately $3,000 per acre-foot.

Suitable groundwater and surface water sources are available that can be treated through conventional means at a significantly less cost. Sources of water supply include the Rio Grande River, Hueco and Mesilla Bolsons, Capitan Reef, Antelope Valley, Wildhorse Ranch, and Dell City. A summary of the sources along with the estimated production/treatment costs is included in Table 4.

Rio Grande - The Rio Grande originates in southwestern Colorado and northern New Mexico, where it derives its headwaters from snowmelt in the Rocky Mountains. The Elephant Butte Dam and Reservoir in New Mexico is approximately 125 miles north of El Paso and can store over two million acre-feet of water. Water in the reservoir is stored for seasonal release to meet irrigation demands in the Rincon, Mesilla, El Paso, and Juárez Valleys. Above El Paso, flow in the River is largely controlled by releases from Caballo Reservoir located below Elephant Butte; while downstream from El Paso to Fort Quitman, flow consists of treated municipal wastewater from El Paso, treated and untreated municipal wastewater from Juárez, and irrigation return flow. El Paso obtains Rio Grande water through contracts with various irrigation districts. The cost of Rio Grande water to the city of El Paso is approximately $300 per acre-foot.

Hueco Bolson Aquifer - The Hueco Bolson aquifer extends from east of the Franklin Mountains in El Paso County southeastward into southern Hudspeth County, and is bounded on the east and north by the Hueco Mountains, the Diablo Plateau, and the Quitman Mountains. The aquifer also extends to the Sierra Juárez in Mexico. The Hueco Bolson along with the Mesilla Bolson (on the west side of the Franklin Mountains) provides approximately half of the municipal supply for the City of El Paso. It has been estimated that, in 2002, fresh groundwater storage in the El Paso portion of the Hueco Bolson was about 9.4 million acre-feet, and brackish groundwater storage (chloride concentration less than 750 mg/L) was about 12.3 million acre-feet (Hutchison, 2006). Production cost for fresh Hueco Bolson water by El Paso Water Utilities is approximately $163 per acre-foot, and production cost for brackish Hueco Bolson water including desalination at the Kay Bailey Hutchison Desalination Plant is about $534 per acre-foot.

Mesilla Bolson Aquifer - The Mesilla Bolson aquifer lies in the Upper Rio Grande Valley west of the Franklin Mountains and extends to the north into New Mexico where it is primarily used for agricultural and public supply purposes in New Mexico. The City of El Paso's Canutillo well field is located in the Mesilla Bolson. The Canutillo well field includes wells at three different depths, typically called the shallow, intermediate, and deep zones. Production cost for Mesilla Bolson water is approximately $163 per acre-foot.

Capitan Reef Aquifer - The Capitan Reef formed along the margins of the Delaware Basin, a late Paleozoic sea. The reef formed along the western and eastern edges of the basin in arc-like strips 10 to 14 miles wide. The majority of the aquifer is located in Culberson, Hudspeth, Jeff Davis, Pecos, Reeves, Ward, and Winkler Counties. The aquifer generally contains water of marginal quality, with most wells yielding water between 1,000 and 3,000 mg/L TDS. The city of El Paso has purchased Diablo Farms, which overlies the Capitan Reef in Hudspeth and Culberson Counties. Production cost from Diablo Farms for transport to El Paso is estimated to be approximately $1,000 to $1,400 per acre-foot.

Dell City - Dell City is located in northeast Hudspeth County. Groundwater in the Bone Spring-Victorio Peak Aquifer, which underlies the area, occurs in joints, fractures, and solution cavities that have developed in the nearly 2,000 feet of limestone. Groundwater in the area can be classified as slightly- to moderately-saline, with TDS of most of the aquifer water ranging from approximately 1,000 to more than 6,000 mg/L and averaging about 3,500 mg/L. Production cost from the Dell City area for transport to El Paso is estimated to be approximately $1,000 to $1,400 per acre-foot.

Antelope Valley and Wildhorse Ranch – Antelope Valley and Wildhorse Ranch are EPWU-owned lands in Culberson, Jeff Davis, and Presidio Counties. Groundwater in these areas occurs in the West Texas Bolson aquifer system, a series of fault-bounded, basin-filled aquifers. Production cost for these areas for transport to El Paso would be approximately $1,000 to $1,400 per acre-foot.

CONCLUSIONS

EPWU requests the designation of an exempt aquifer in conjunction with the use of its Class V injection wells, TCEQ Authorization No. 5X2700062. EPWU requests that the portions of the aquifer described in this application be exempt for purposes of the use of Class V injection wells to inject discharge water from its desalination plant used to convert brackish groundwater to potable water.

The following conclusions have been reached and support the requirements of 40 CFR § 146.4 and 30 TAC 331.13 for the request of an aquifer exemption.

- The areal extent of the aquifer exemption request is based on the plume that would be generated from the injection of concentrate at a constant rate of 3 MGD for 50 years. Actual rate of injection for the concentrate will be based on plant operation that will be governed by the availability of surface water. Specifically, during times of "full" river allocation, groundwater pumpage from the Hueco Bolson and operation of the plant will be minimal. Under "drought" conditions, groundwater from the Hueco Bolson and operation of the plant will be maximized to make up for the shortage of surface water. In addition to drought protection, the plant will be used to provide for growth, meet peak demands, and be used if there is a disruption in other supplies. It is anticipated that the actual amounts of injection will be, on the average, less that the constant rate of 3 MGD for 50 years. As such, the area requested for the aquifer exemption is considered to be more than sufficient.
- The aquifer is not a source of drinking water for human consumption (Based on field and record searches, there are no known drinking water wells, public or private, extracting water from the aquifer in Texas or New Mexico).
- The aquifer has a TDS level above 3,000 mg/L and less than 10,000 mg/L and is not reasonably expected to supply a public water system. In addition to having a TDS level above 8,000 mg/L, the aquifer does not meet primary water quality standards for arsenic, gross alpha (less Ra and U), nitrite, and radium, making the use of groundwater from the aquifer impractical for human consumption. Under

this is not one of the 2 criteria selected

this is 146.5(C)

current conditions, the chemical composition of the desalination concentrate (injectate) has a TDS less than 6,000 mg/L. Thus, the concentrate has an overall higher quality than the proposed exempt aquifer.

- Alternative sources of drinking water (Rio Grande, Hueco Bolson, Mesilla Bolson, Capitan Reef Aquifer, Dell City, Antelope Valley, and Wildhorse Ranch) are available. These alternative sources have a higher quality (1,000 to 3,000 mg/L TDS as compared to over 8,000 mg/L TDS) and can be produced at a significantly less cost per acre-foot basis ($163 to $1,400 per acre-foot as compared to $3,000 per acre-foot).
- The remoteness and depth (2,200 to 2,890 feet) renders the aquifer an economically and/or technologically impractical source of drinking water.
- Favorable hydrogeologic conditions exist for the storage and containment of brines injected into the aquifer. (The aquifer has sufficient porosity and permeability to support injection for the fifty-year operation of the Kay Bailey Hutchison Desalination Facility. Sufficient vertical confinement is also maintained throughout the proposed exemption area.)
- The aquifer not only produces hydrocarbons in West Texas and Southeast New Mexico but also is utilized as an injection zone for disposal of oilfield brine in these areas.
- The water quality of the injected fluids does not significantly affect the existing groundwater quality of the proposed exempt aquifer. Regardless of current or projected concentrate disposal levels, the same membrane treatment would be required prior to using the groundwater as a source of drinking water.

Is the argument that the level of treatment would remain the same as it is today if injection were allowed A good argument?

I'm proposing this argument they are inferring that the fluids are treatable. Does this bring into question their criteria selection that the depth or location that makes recovery of water economically or technologically impractical?

Tables

None except the injection wells & 2 test wells penetrate the zone

Table 1 Artificial Penetrations in the Area of Review

	State	State Well ID/ State Tracking No.	Owner	Driller	Year Drilled	Total Depth (ft.)	Hole Diameter (in.)	Casing Diameter (in.)	Casing Length (ft.)	Avail. Lith. Log	Remarks
✓	Texas	JDF-1	EPWU	United Drilling	2004	3,775	17.5 – 8.75	13.4 – 6.6	0 – 3,775	Y	Class V Injection Well.
✓	Texas	JDF-2	EPWU	United Drilling	2006	3,723	17.5 – 8.75	13.4 – 6.6	0 – 3,723	Y	Class V Injection Well.
✓	Texas	JDF-3	EPWU	United Drilling	2006	3,996	17.5 – 8.75	13.4 – 6.6	0 – 3,996	Y	Class V Injection Well.
✓	Texas	TH-1	Corp of Engineers	Stewart Bros.	2003	3,095	8.75 – 5.1	6.5	0 - 686	Y	COE test hole.
	Texas	TH-2	Corp of Engineers	Stewart Bros.	2003	972	8.75 - 6	6.5	0 – 583	Y	COE test hole.
✓	Texas	TH-3	Corp of Engineers	Stewart Bros.	2003	2,894	8.75 – 5.1	5	0 - 1,095	Y	COE test hole. Plugged.
	Texas	TH-4	Corp of Engineers	Stewart Bros.	2003	575	8.75 – 6.25	6.5	0 - 480	Y	COE test hole.
	Texas	GT-6	UTEP Study	--	1980?	164	4.5	1.25 pvc	0 - 164	--	Temperature gradient hole. Abandoned and unlocated.
	Texas	GT-12	UTEP Study	--	1980?	1,006	4.5	1.25 iron	0 – 1,006	--	Temperature gradient hole. Abandoned and unlocated.
* 1	Texas	49-15-301	El Paso County Road & Bridge	Cole Drilling Co.	1975	558	--	10.75	558	N	Shallow well and does not penetrate injection zone.
2	Texas	49-15-302	D.R. Ponde	--	1962	510	--	10	--	N	Shallow well and does not penetrate injection zone.
3	Texas	49-15-303	El Paso County Road & Bridge	Cole Drilling Co.	1985	508	--	10	508	N	Shallow well and does not penetrate injection zone.
	Texas	49-15-601	U.S. Geological Survey	B & W Drilling Co.	1953	1,013	--	--	--	N	Test hole, P&A.
	Texas	49-15-602	J. Navar	Unknown	1976	1,100		--	--	N	Livestock well, P&A.
4	Texas	49-15-603	Jerry Bales	Unknown	1977	420	--	6.0 – 5.0	0 – 300 300 - 320	N	Shallow well and does not penetrate injection zone.
5	Texas	49-15-605	Richard Helms	Richard Lee Helms	1980	470	--	6	0 – 470	N	Shallow well and does not penetrate injection zone.
6	Texas	49-15-609	Homestead M.U.D. #2	Cole Drilling Co.	1986	633		12	633	N	Shallow well and does not penetrate injection zone.
7	Texas	49-15-610	Homestead M.U.D. #2	Cole Drilling Co.	1986	630	--	10	630	N	Shallow well and does not penetrate injection zone.

* We must assume those wells < 650' are water supply wells for the individuals or company listed

8	Texas	49-15-611	El Paso County Road & Bridge	Cole Drilling Co.	1986	610		10.75	610	N	Shallow well and does not penetrate injection zone.
9	Texas	49-15-613	El Paso County Road & Bridge	Unknown	1988	510	--	10	0 – 510	N	Shallow well and does not penetrate injection zone.
10	Texas	49-15-614	El Paso County Road & Bridge	B&G Drilling	1990	515		6	515	N	Shallow well and does not penetrate injection zone.
	Texas	49-15-615	East Mount	Unknown	1985	500	--	--	--	N	Shallow well and does not penetrate injection zone.
	Texas	49-15-902	J. Navar	Unknown	--	1,100	--	--	--	N	No sign of well on 8/7/01
	Texas	49-15-904	El Paso Natural Gas	Layne Texas	1968	551		--	--	N	No sign of well on 8/7/01
	Texas	72872	Jobe Materials	R.L. Guffey, Inc.	2005	592	23	12.75	592	Y	Industrial, reported undesirable water quality, did not complete.
deepest → private well 11	Texas	89984	Jobe Materials	Skinner Drilling	2006	1,100	10	--	--	Y	Borehole and surface completed by prior driller. See #72872.
12	Texas	49-07-9A	E.W. McCracken	Coles-Aqua Drilling Co.	1983	515	12.25	6-5/8	515	Y	Shallow well and does not penetrate injection zone.
	Texas	49-07-9B	Paso View Water Corp.	Richard Lee Helms	1984	545	--	--	--	Y	No water, no completion.
13	Texas	49-15-3	Galindo Arcenio	Richard Lee Helms	1986	500	14.75	6	500	Y	Shallow well and does not penetrate injection zone.
14	Texas	49-15-3X	Raul Rodriguez	Joe Salazar	1995	500	9.75	5	500	Y	Shallow well and does not penetrate injection zone.
15	Texas	49-15-6	George Demings	Richard Lee Helms	1986	502	14.75	6	502	Y	Shallow well and does not penetrate injection zone.
	Texas	49-15-6B	John Barnett	Richard Lee Helms	1981	545	10	--	--	Y	No water, no completion.
	Texas	49-15-6C	John Barnett	Richard Lee Helms	1981	520	10	--	--	N	No water, no completion.

15 wells of interest

Table 2

Proposed Exempt Aquifer Water Quality Analyses

In milligrams per liter (mg/L)

Parameter	Primary Standard	Injection Well			50-Year Projection
		JDF-1	JDF-2	JDF-3	
Antimony	0.006	N/A	< 0.01	< 0.01	BDL
Arsenic	0.01	0.0106	< 0.01	< 0.01	0.075
Barium	2	N/A	0.055	0.056	1.2
Beryllium	0.004	N/A	< 0.004	< 0.004	BDL
Cadmium	0.005	N/A	< 0.003	< 0.003	BDL
Chromium	0.1	N/A	< 0.010	< 0.010	BDL
Cyanide	0.2	N/A	< 0.02	< 0.02	BDL
Fluoride	4	3.11	1.09	1.12	4
Gross Alpha (less Ra and U)	15	412 ± 56.721	620 ± 170	774 ± 40	30
Mercury	0.002	N/A	< 0.0005	< 0.0005	BDL
Nitrate	10	< 0.5	< 0.10	< 0.10	2
Nitrite	1	1.14	< 0.05	< 0.05	BDL
Ra-226 + Ra-228	5	N/A	15 ± 1	19 ± 2	3
Selenium	0.05	N/A	< 0.010	< 0.010	0.015
Thallium	0.002	N/A	< 0.010	< 0.010	BDL
Uranium (ug/l)	30	N/A	21	8.6	29

= Does Not Meet Primary Standard

BDL = Below Detection Limit

These wells are in fairly close proximity to each other. The variability of MCL exceedences tells me the contamination is only pervasive for Gross Alpha.

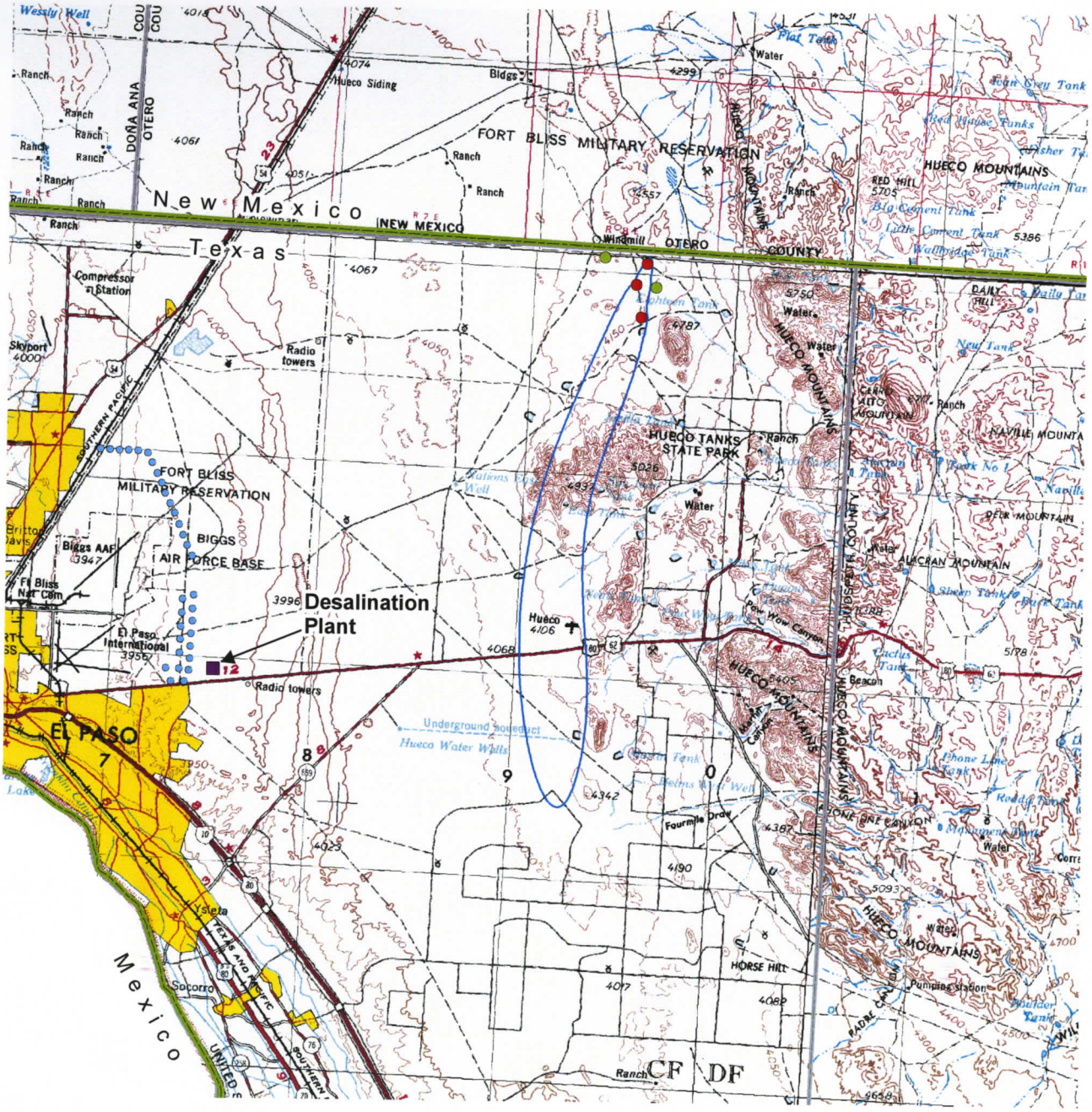
Table 3 Properties of the Proposed Exempt Aquifer

Parameter	Value	Source
Porosity	6.3%	Determined from correlation of JDF-1 core data, formation density/neutron logs, fracture identification processing and post injection temperature survey.
Hydraulic Conductivity	7.02E-04 ft/sec	Determined from aquifer tests.
Thickness	2,480 ft.	Determined from open hole logs, temperature survey, and measured thickness in Franklin Mtns.
Temperature	155.45°F at 2,315 ft. 161.81°F at 3,765 ft.	Determined from initial well testing on JDF-1.
Density	1.0052 g/cm^3	Measured in JDF-1.
Viscosity	0.397 cp	Calculated from fluids property input module in the PanSystem2 analysis software (Van Wingen, 1950).
Static Pressure	786.82 psia at 2,303 ft.	Measured in JDF-1.

Table 4 Available Water Resources and Associated Production Costs

Water Supply	Production Cost (Acre-Foot)
Rio Grande	$300
Hueco Bolson	$163 (Fresh), $534 (Brackish)
Mesilla Bolson	$163
Capitan Reef	$1,000 to $1,400
Dell City	$1,000 to $1,400
Antelope Valley, Wildhorse	$1,000 to $1,400
Exempt Aquifer	$3,000

Figures



- Class V Injection Wells
- Authorized Injection Wells
- Production Wells
- State Boundary
- Counties
- Proposed Exempt Area

N

0 2 4 8 Miles

GENERAL LOCATION MAP **FIGURE 1**

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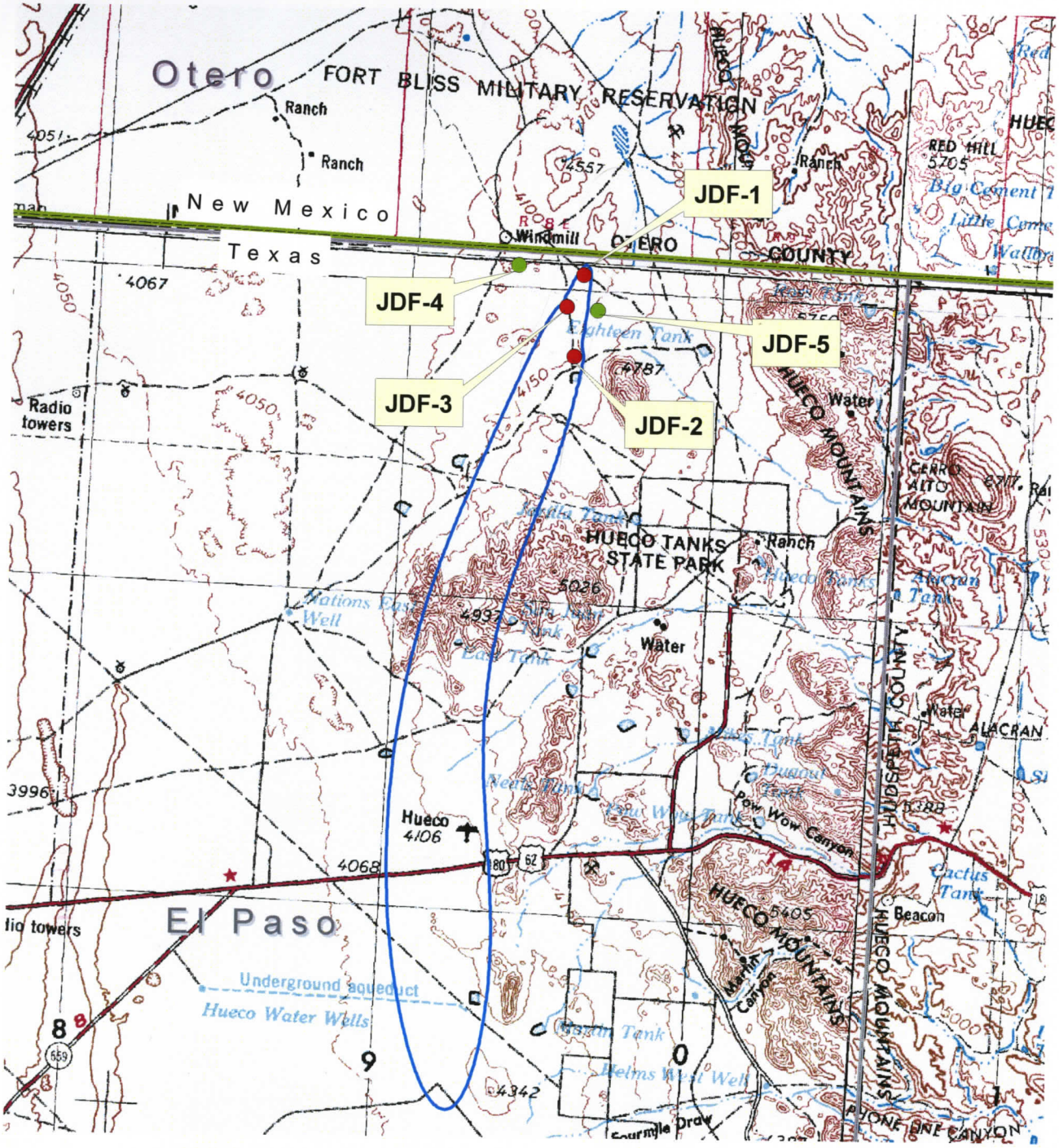

Legend

- Active Injection Well
- Authorized Injection Wells
- State Boundary
- County Boundary
- Proposed Exempt Area

N

0 1 2 4 Miles

PROPOSED EXEMPT AREA — **FIGURE 2**

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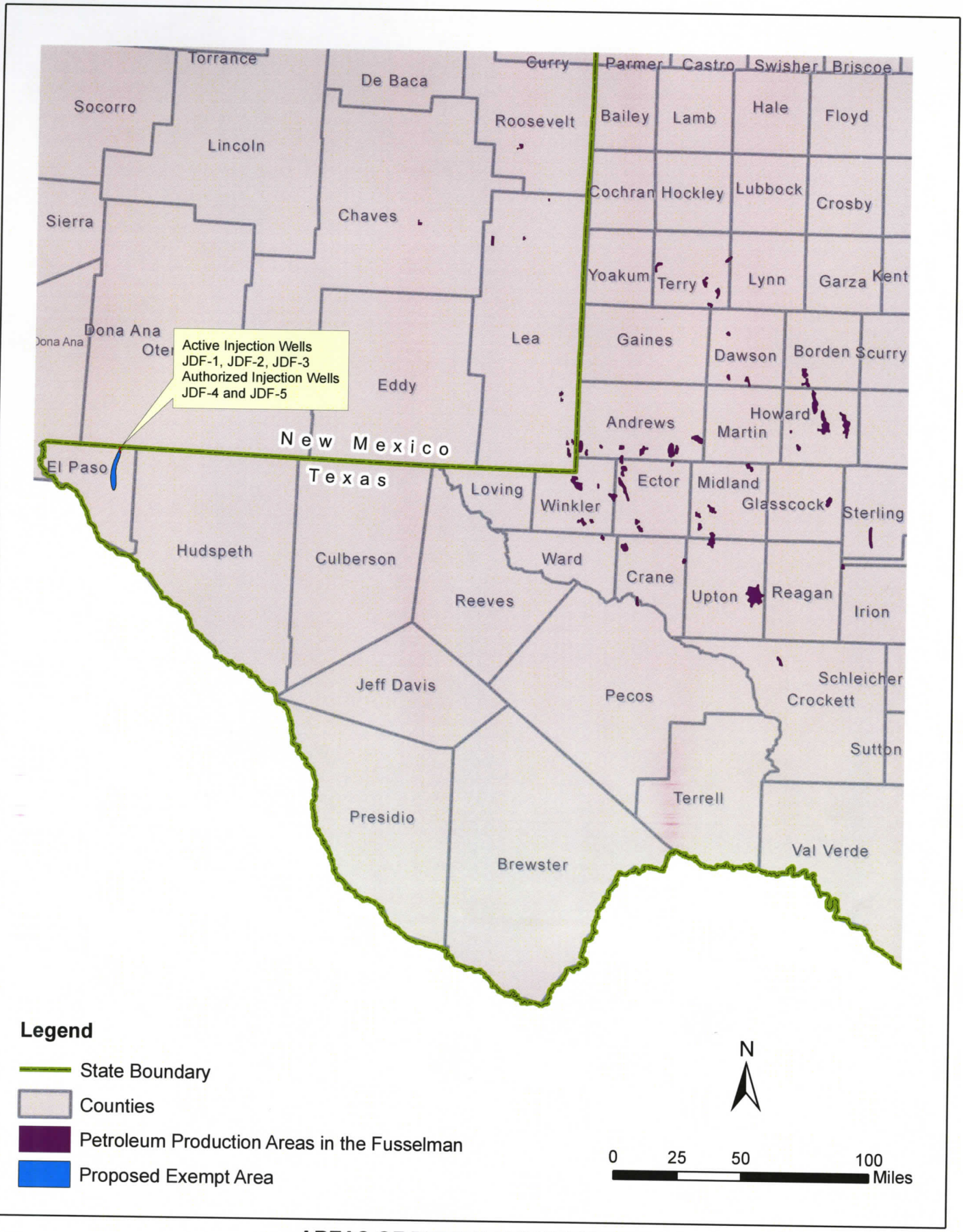
The fact that the state's permit allows for 2 more wells to be drilled, and the exemption modeling does not account for those wells injection, raises questions on the adequacy of the modeling.



AREAS OF PETROLEUM PRODUCTION IN THE FUSSELMAN

FIGURE 3

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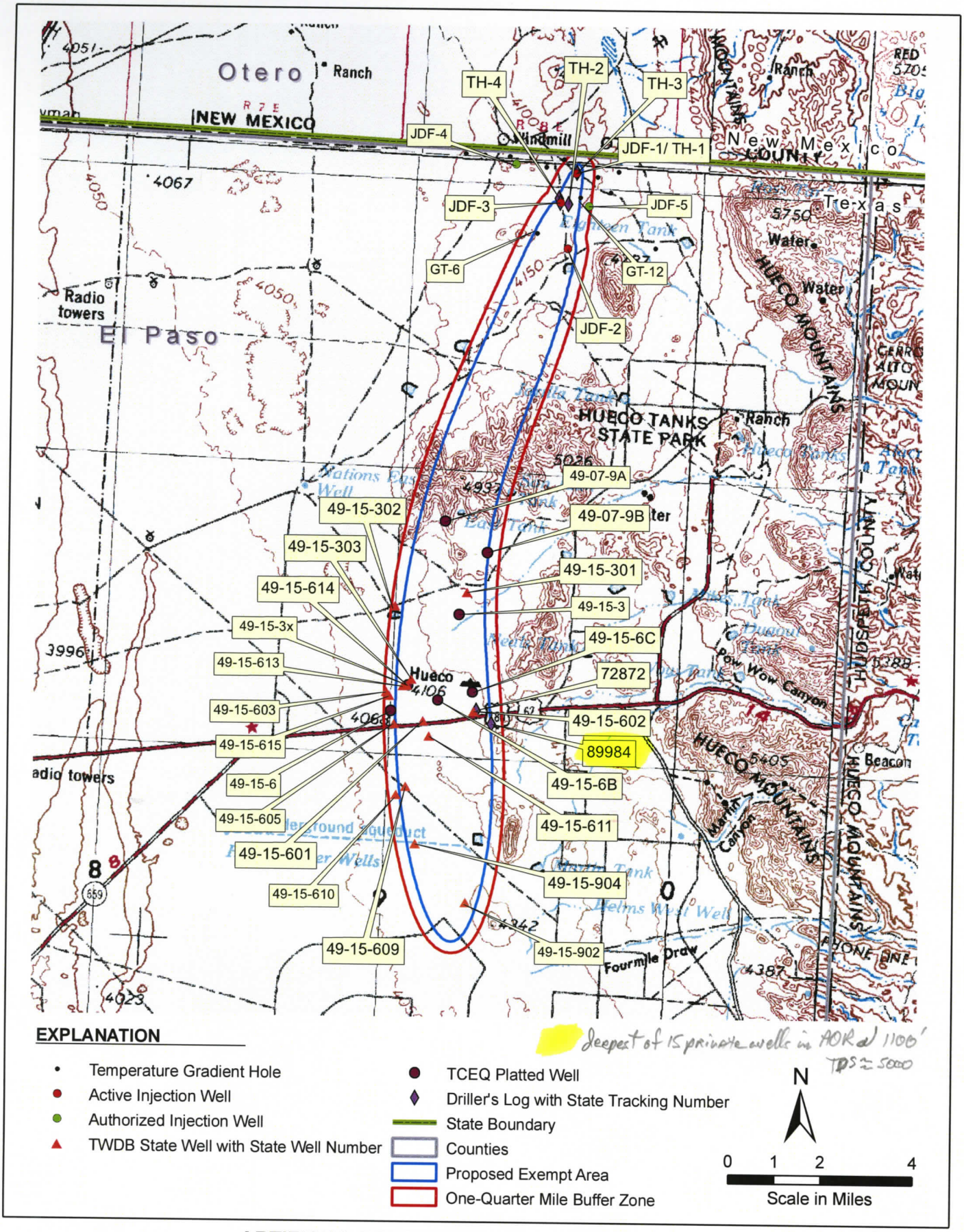

ARTIFICIAL PENETRATIONS IN AREA OF REVIEW **FIGURE 4**

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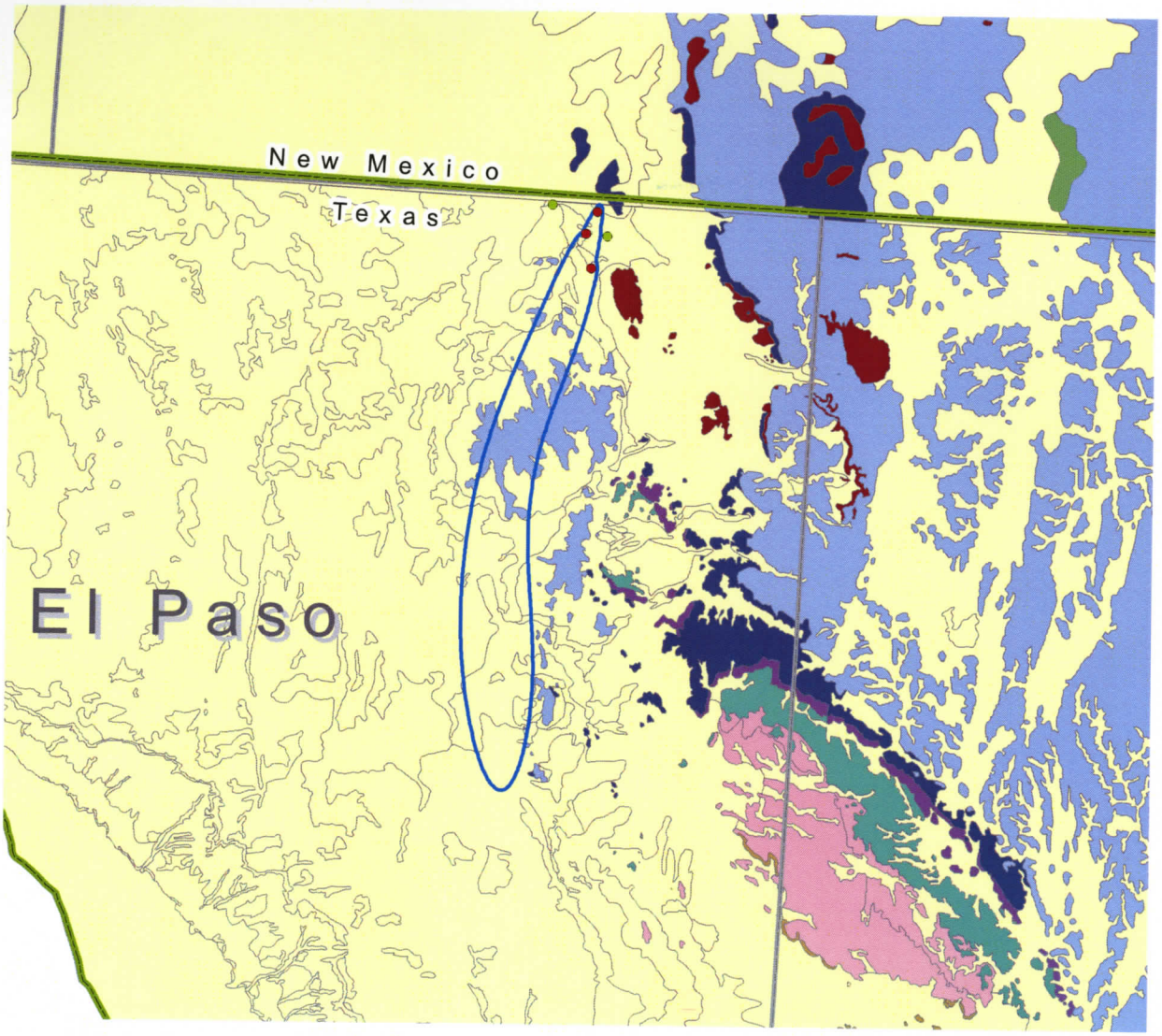

Legend

- Active Injection Wells
- Authorized Injection Well
- Proposed Exempt Area
- County Boundary
- State Boundary

GEOLOGIC UNIT BY AGE

- Quaternary and Tertiary Bolson and Alluvial Deposits
- Tertiary Igneous
- Cretaceous
- Permian
- Pennsylvanian
- Mississippian and Devonian
- Silurian ← Fusselman outcrop
- Ordovici
- Precamb

5 10 Miles

REGIONA

FIGURE 5

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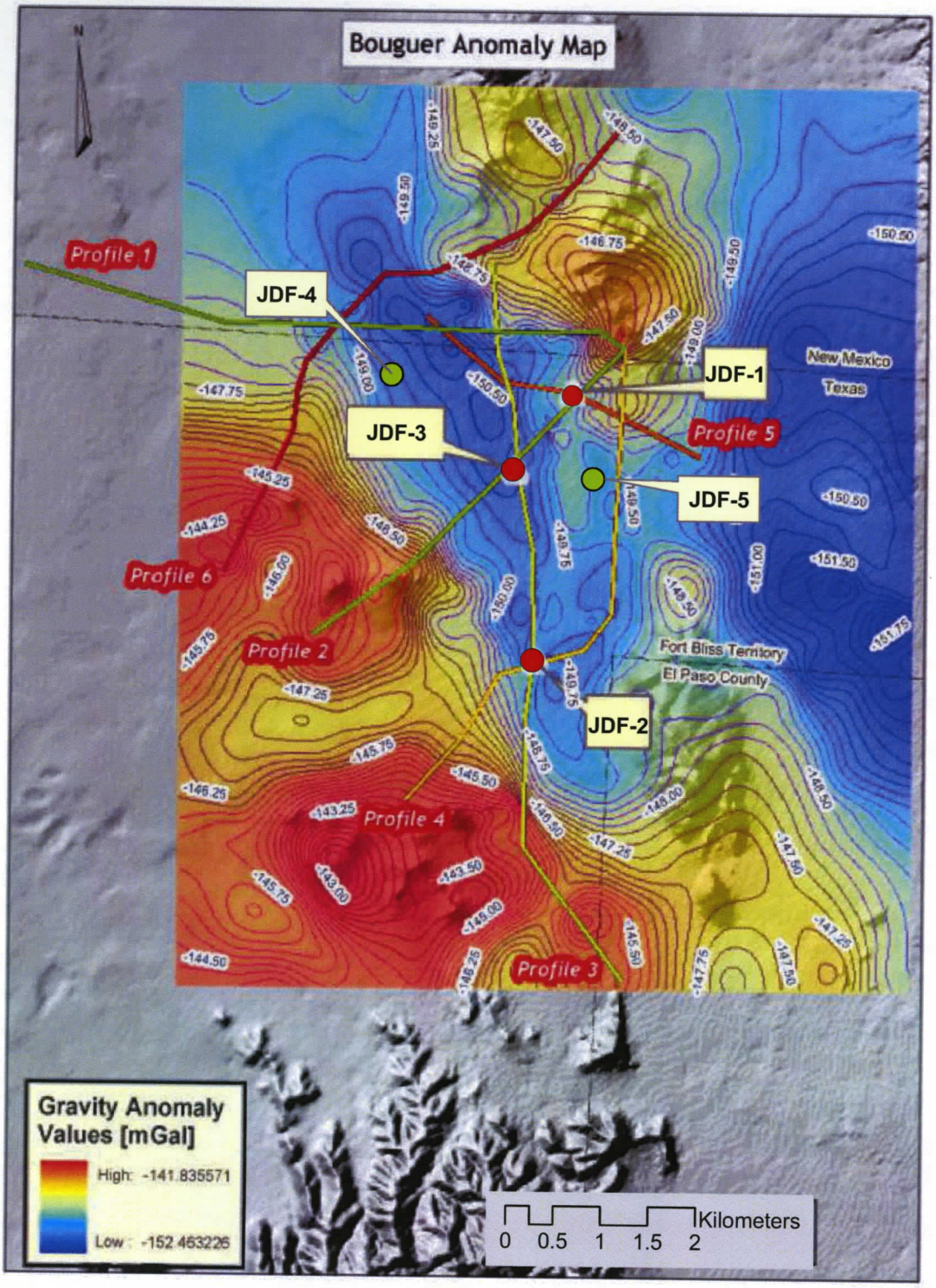
REGIONAL STRATIGRAPHIC COLUMN

AGE	GEOLOGIC UNIT		MAX THICK.	DESCRIPTION
Quaternary	Young deposits		200'	River and stream alluvium, lacustrin and fluviatile deposits, colluvium, and fan deposits.
	Old deposits		< 100'	Alluvium, colluvium, caliche, and gypsite on surfaces dissected by modern drainage.
Tertiary	Hueco Bolson	Camp Rice Fm.	10,000'	Fluvial deposits of sand, silt,and clay.
		Fort Hancock Fm.		Lacustrine deposits of silt and clay.
	Intrusive igneous rocks			Stocks, loccoliths, sills, and dikes of rhyolite, porphyry, quartz monzonite, monzonite, granodiorite, granite, syenite, trachyte, basalt, and altered diabase.
Cretaceous	Cretaceous rocks undivided		3,000'	Small outcrops of limestone, marl, shale and sandstone.
Permian	Hueco Limestone	Upper	386' *	Limestone, olive gray, medium to very thick bedded.
		Middle	1,171' *	Limestone, light to dark gray, medium to thick undulatory beds.
		Lower	742' *	Calcareous mudstone, marl and limestone-pebble congomerate.
Pennsylvanian	Magdalena Formation		2,700'	Limestone, shale and marl; light gray to black, very thick bedded.
Mississippian	Helms Shale		231' *	Gray and green shale, sandstone, and fossiliferous limestone.
	Rancheria Formation		370' *	Limestone, black, argillaceous, bituminous, and cherty.
	Las Cruces Limestone		90' *	Limestone, black, aphantic, evenly bedded.
Devonian	Percha Shale		99' *	Black shale.
	Canutillo Formation		175'	Limestone, light brown and gray, fossiliferous, in part cherty.
Silurian	Fusselman Dolomite		640' *	Dolomite, dolomitic limestone, and locally limestone, white to light gray, aphantic to coarse grained, thick bedded.
Ordovician	Montoya Dolomite		405' *	Dolomite and limestone, white to dark gray, apharitic to coarse grained, thin to thick bedded, thin sandstone bed locally at base.
	El Paso Group		1,590'	Limestone, in part cherty, and dolomite, in part sandy.
	Bliss Sandstone		250'	Sandstone, fine to coarse grained, medium to thick bedded.
Precambrian	Igneous Extrusives		1,100'	Granite, pink to red, and extrusive ashflow tuff and lava.
	Lanoria Quartzite		2,600'	Sandstone, quartzite, siltstone, and slightly metamorphosed shale.
	Mundy Breccia		190' *	Black basalt boulders, randomly oriented, in matrix of dark gray mudstone.
	Castner Limestone		1,112' *	Limestone, siltstone, and shales metamorphosed into marbles and hornfels.

* From Harbour (1972) "Geology of the Northern Franklin Mountains, Texas and New Mexico".

REGIONAL STRATIGRAPHIC COLUMN

FIGURE 6



Spline tension Interpolation, Wt. 10, No. of Points 12, Grid cell size at 1 second (101.45 ft.)

Note the deeper troughs of the Fusselman running NW → SE

BOUGER ANOMALY MAP **FIGURE 7**

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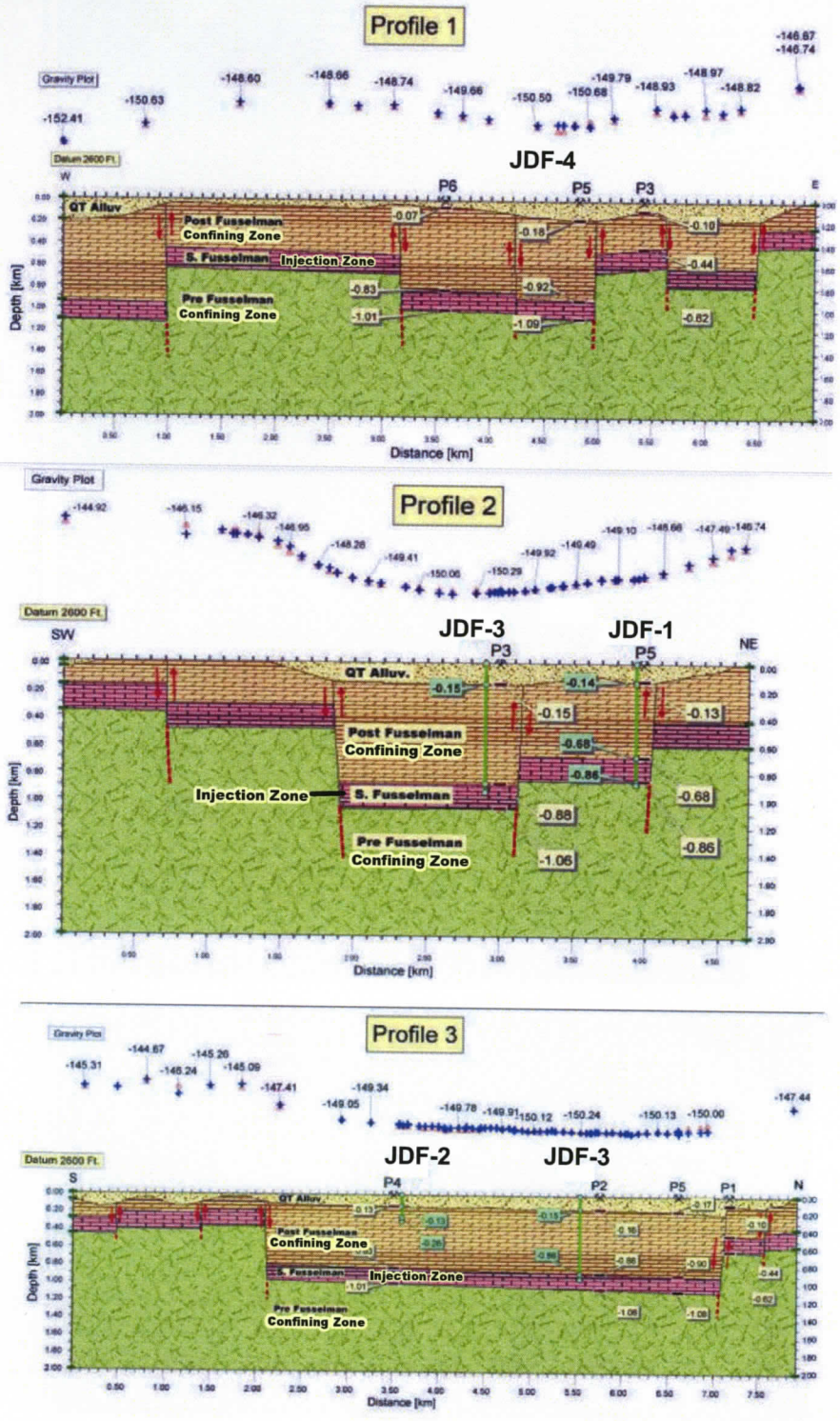

BOUGER PROFILES 1, 2, AND 3

FIGURE 8

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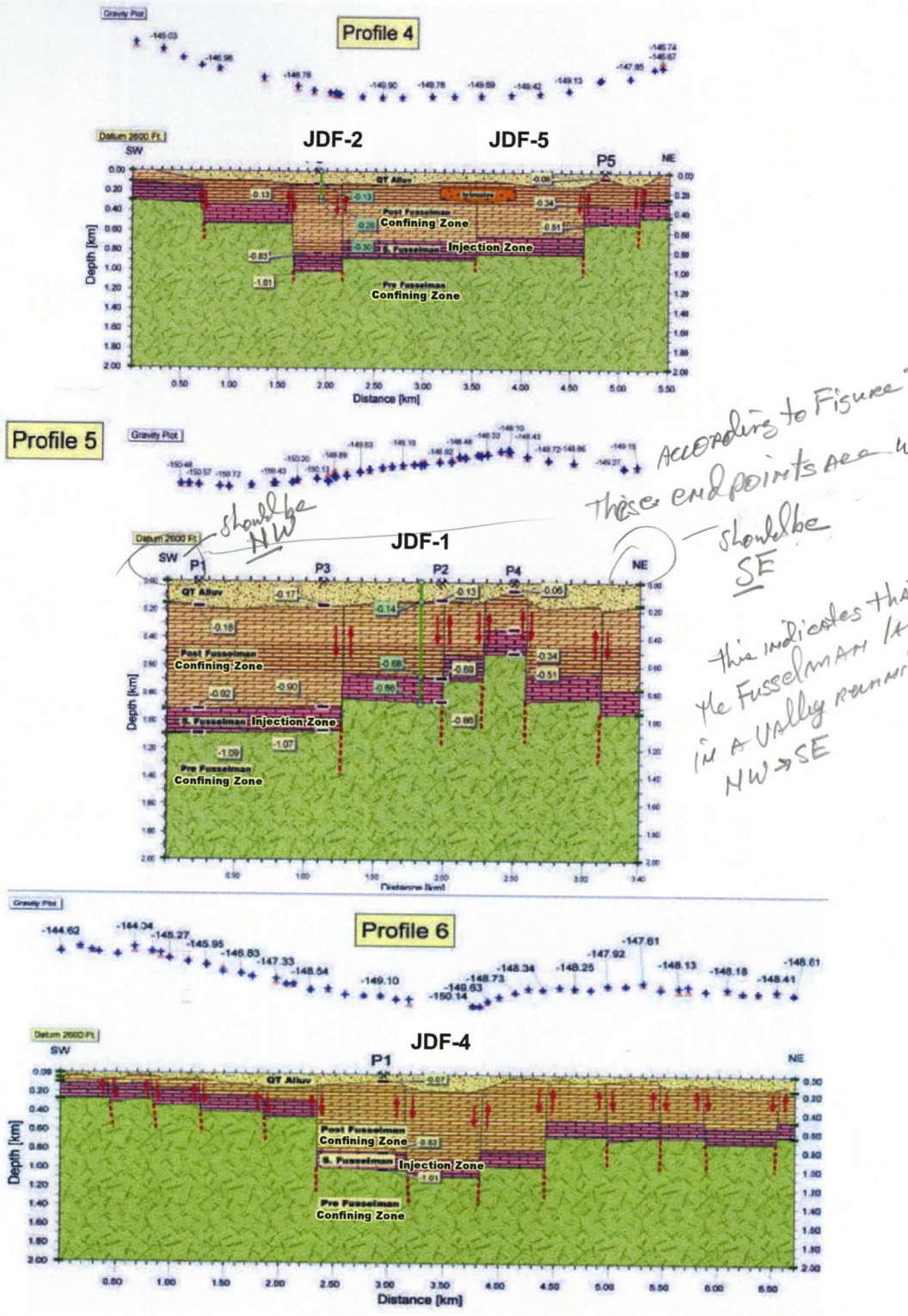


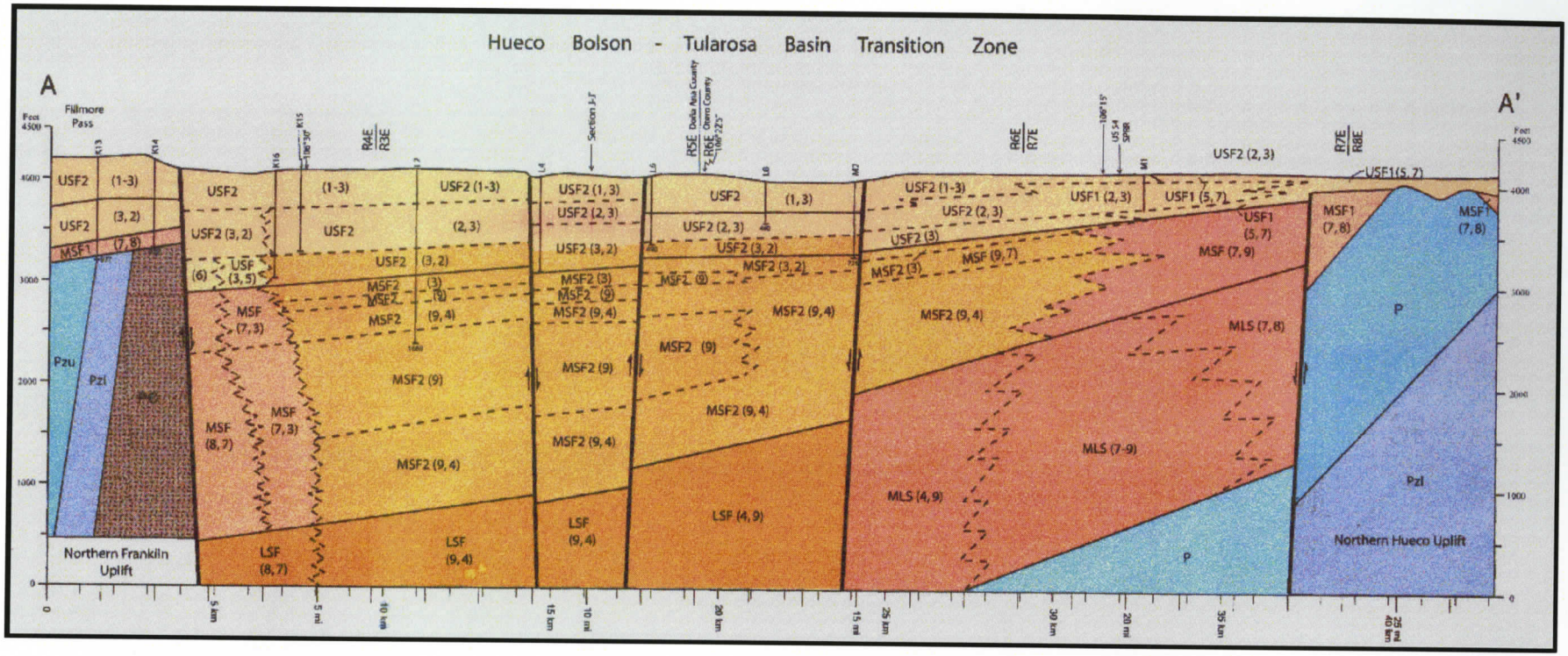
According to Figure 7 these endpoints are WRONG, should be NW

should be SE

this indicates that the Fusselman lays in a valley running NW → SE

BOUGER PROFILES 4, 5, AND 6 **FIGURE 9**

LBG-GUYTON ASSOCIATES



EXPLANATION

Santa Fe Group HSUs

- USLM — *Middle Pleistocene to Pliocene, Upper Santa Fe HSUs, sandy, fluvial and eolian sediments (with partially indurated clacic paleosols) of the La Mesa geomorphic surface; up to 20 ft (6 m) thick and entirely in the vadose zone; up to 10 ft (3 m) of upper Quaternary eolian cover is locally present*
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- USFc — *Pliocene to Late Miocene, Upper Santa Fe HSUs, mostly proximal piedmont facies 6 and 8; includes Camp Rice Formation subdivisions*

PRE-SANTA FE GROUP BEDROCK UNITS

- Ti — *Lower Cenozoic; intermediate-composition volcanicrocks; primarily andesitic intrusions; generally porphyritic; locally includes epiclastic rocks derived from Ti. Includes intrusionsin the Vado Hill to Paso del Norte and Diablo Plateau-Otero Mesa area*
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- Pzl — *Lower Paleozoic Rocks, Cambrian to Silurian, primarily carbonate types*
- XY — *Precambrian Rocks (Undifferentiated)*

FIGURE 10. HAWLEY CROSS SECTION A-A'

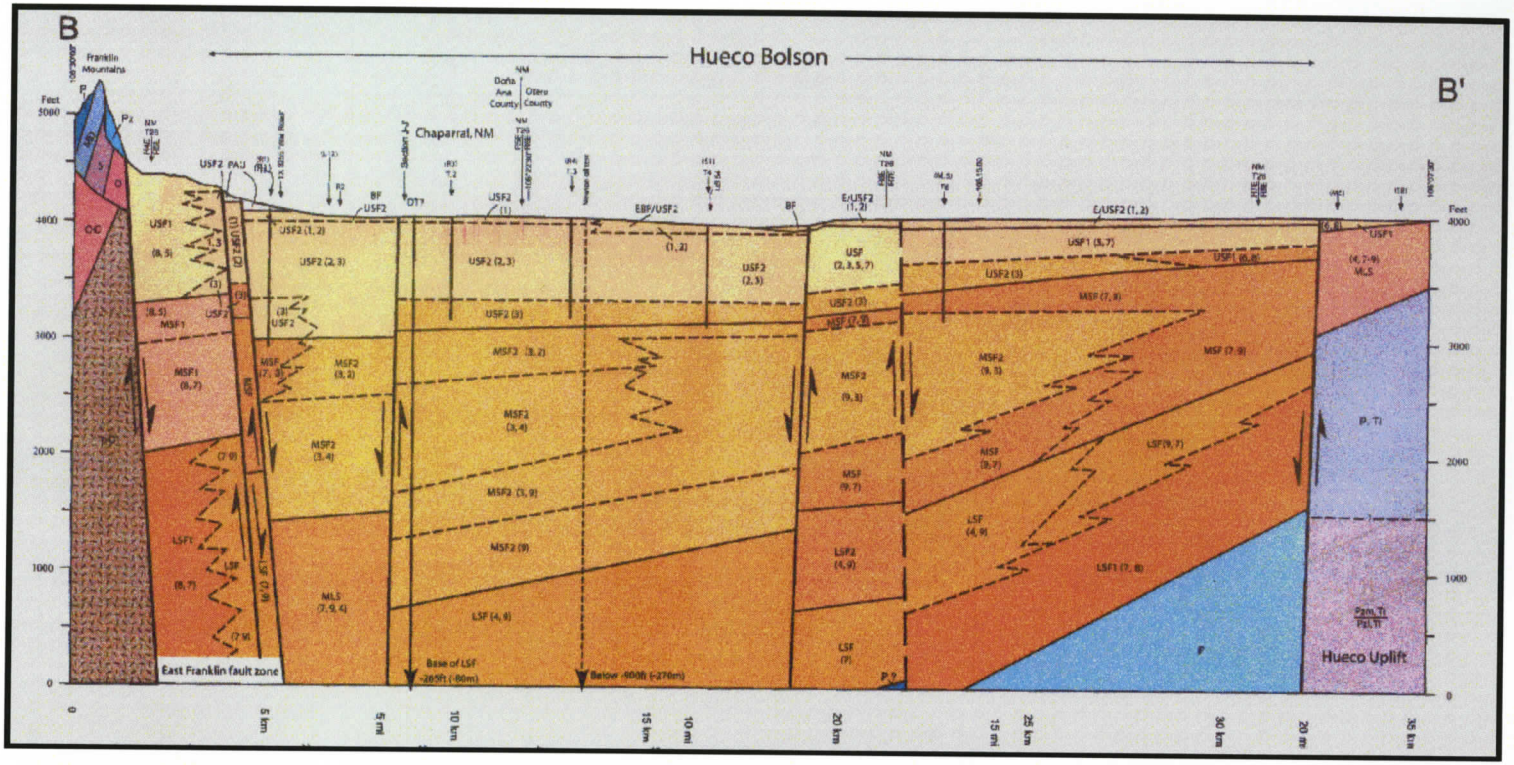

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FIGURE 11. HAWLEY CROSS SECTION B-B'

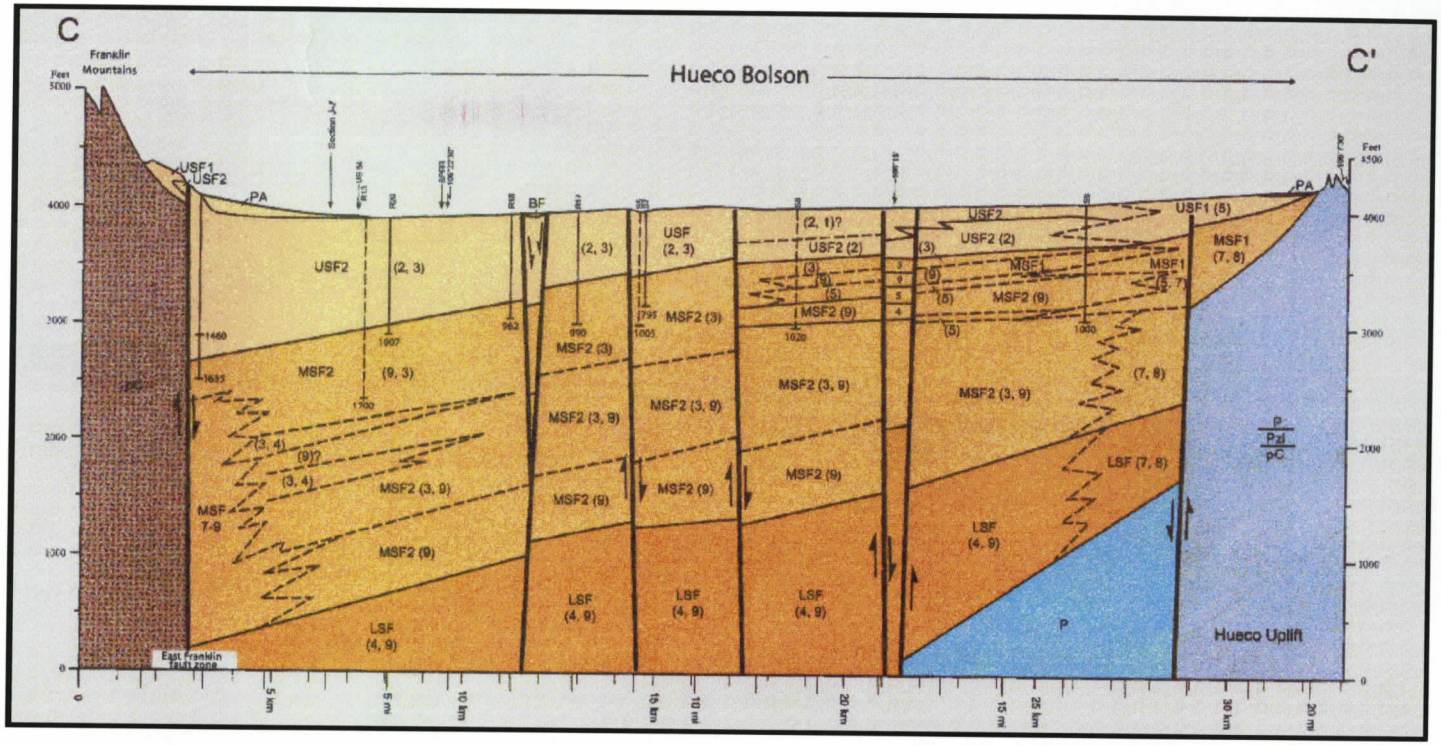

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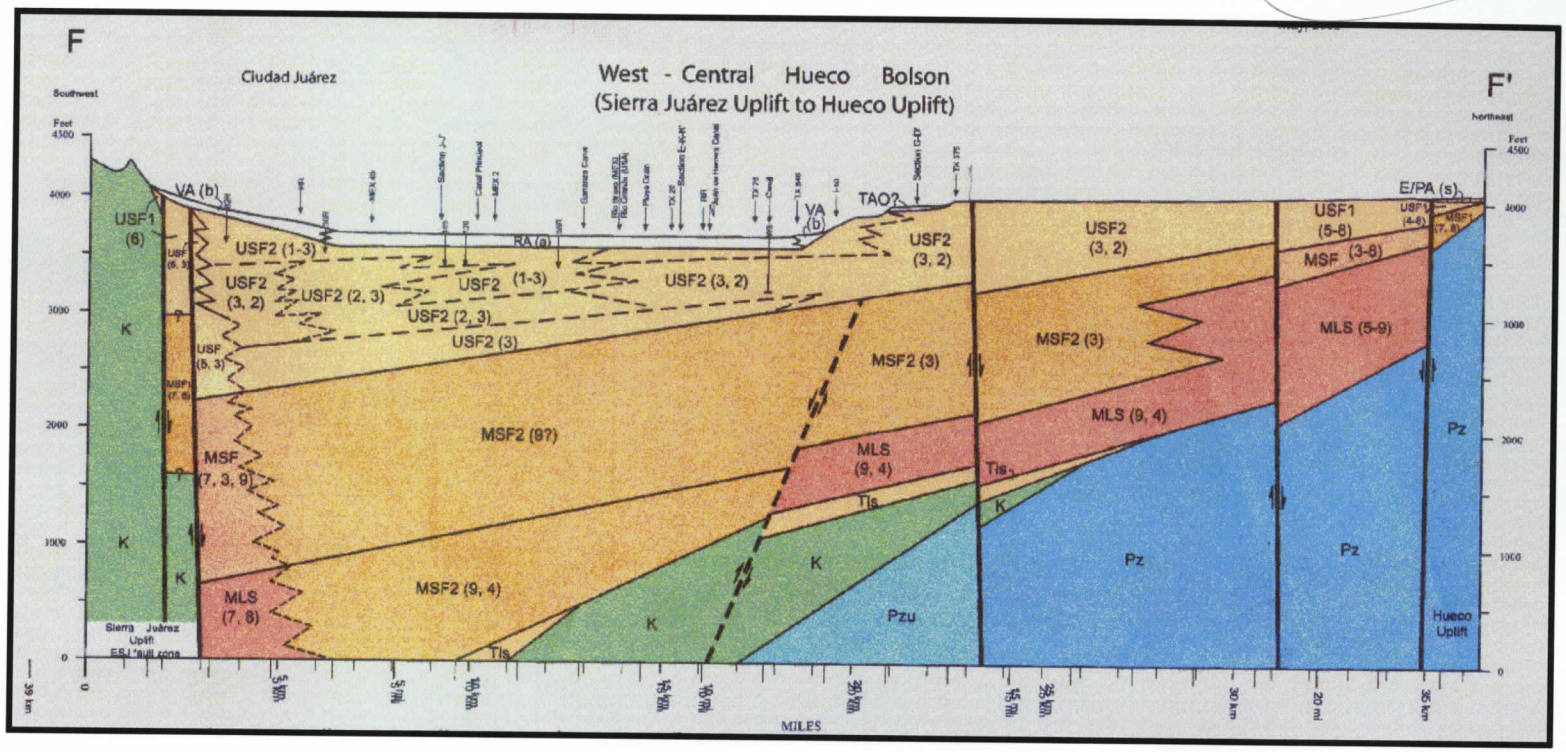
FIGURE 12. HAWLEY CROSS SECTION C-C'

NO D-D'
NO E-E'



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- XY — *Precambrian Rocks (Undifferentiated)*

FIGURE 13. HAWLEY CROSS SECTION F-F'

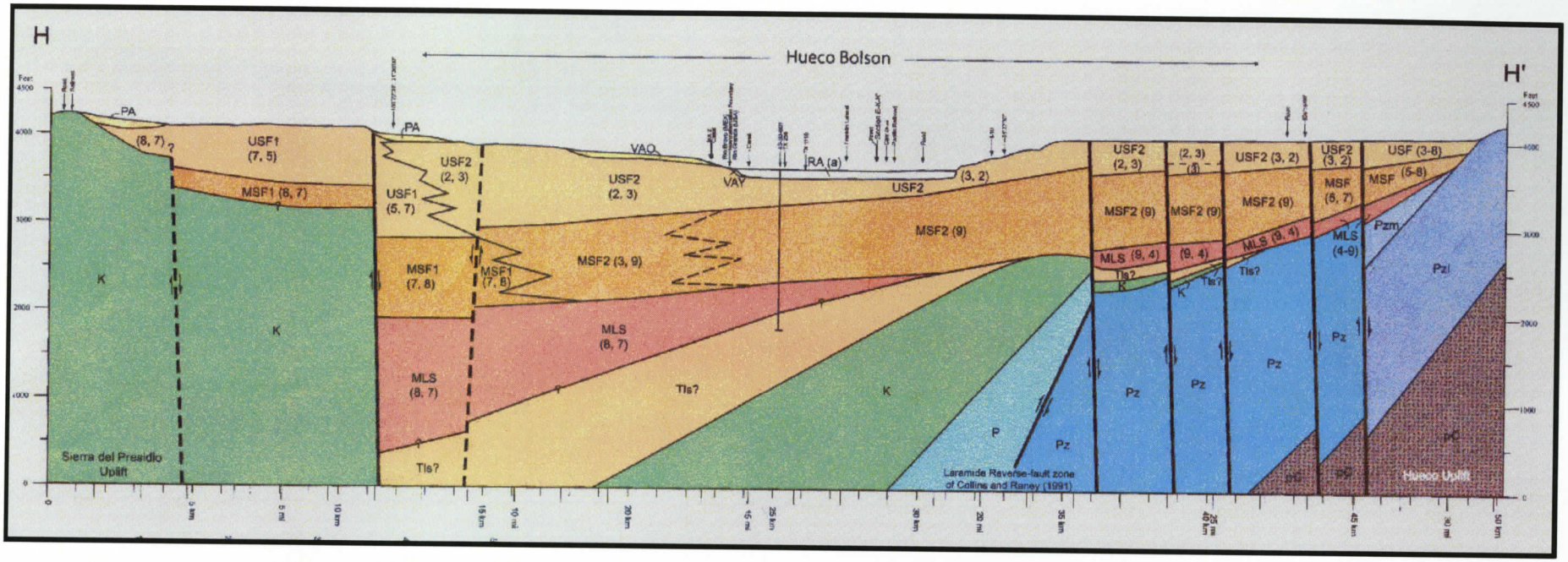

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FIGURE 14. HAWLEY CROSS SECTION H-H'

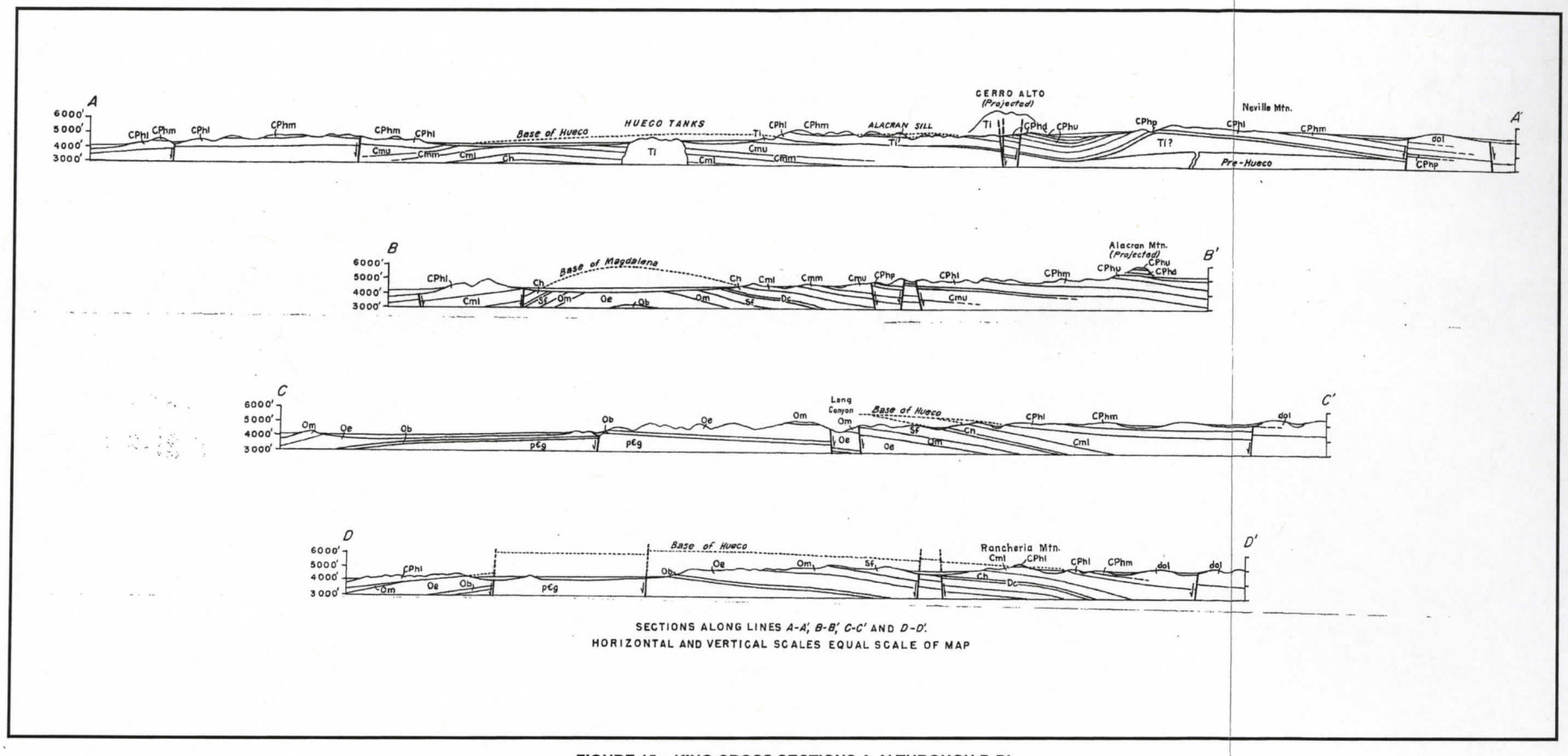


FIGURE 15. KING CROSS SECTIONS A-A' THROUGH D-D'

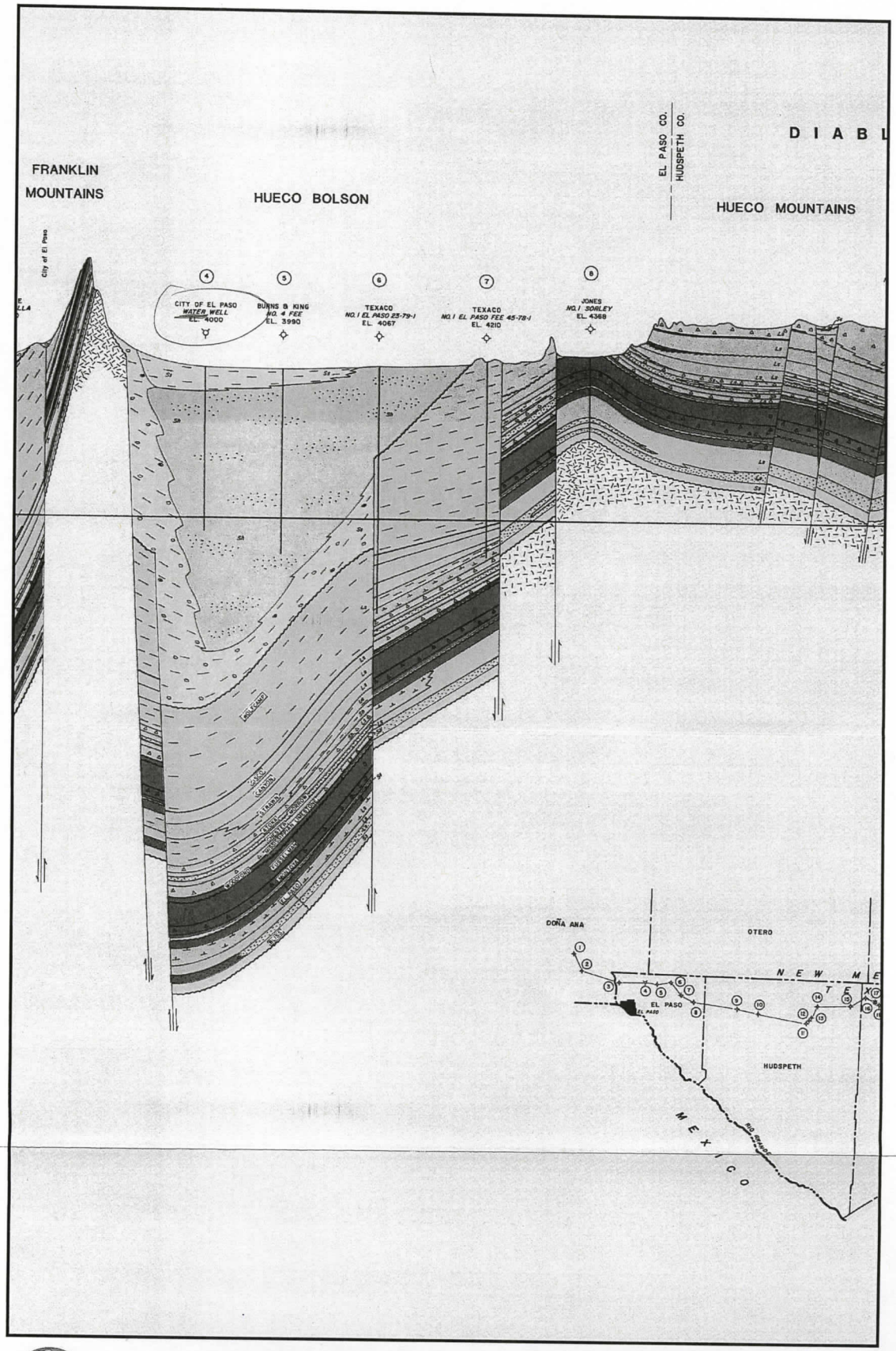
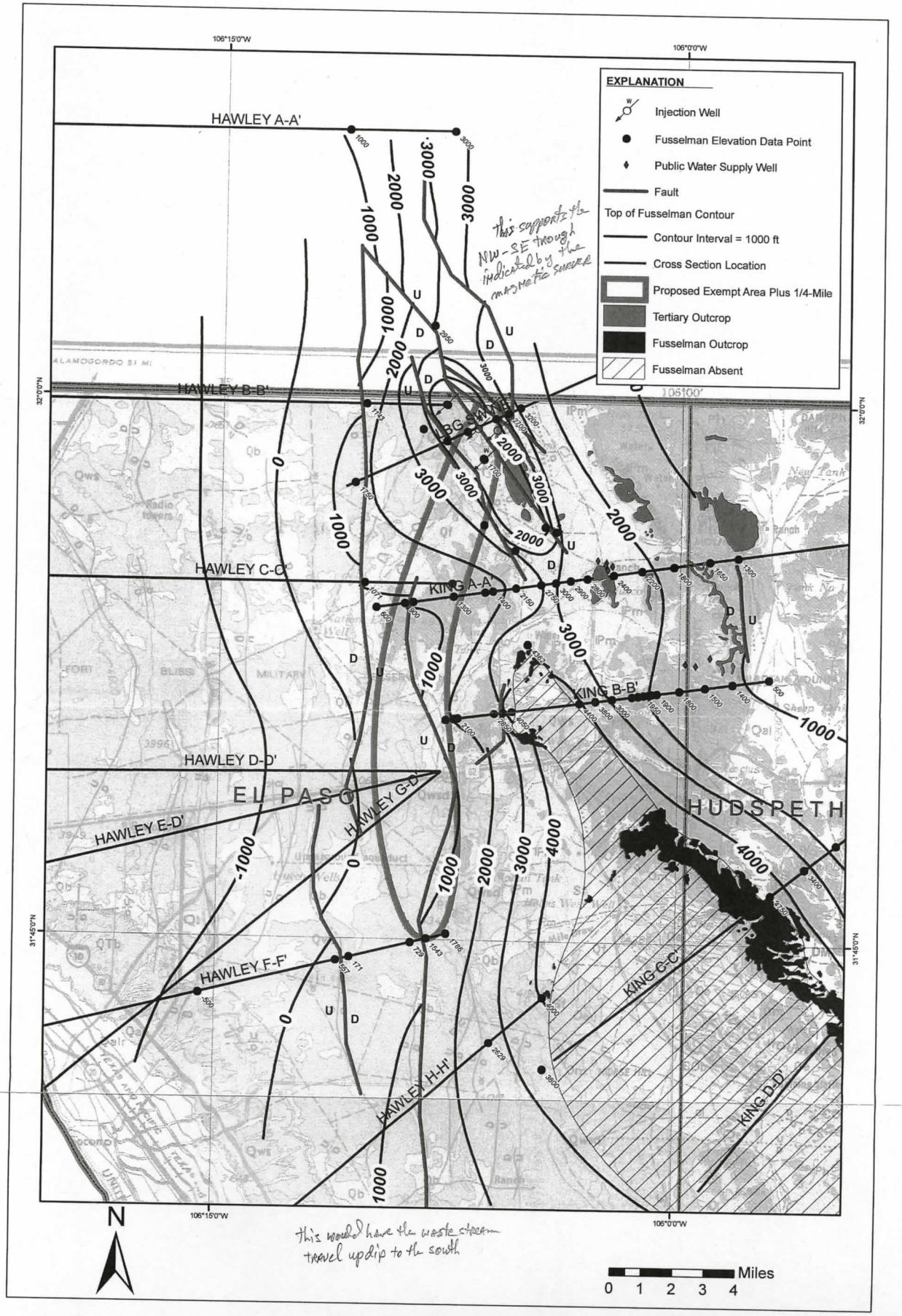


FIGURE 16. WTGS WEST-EAST CROSS SECTION

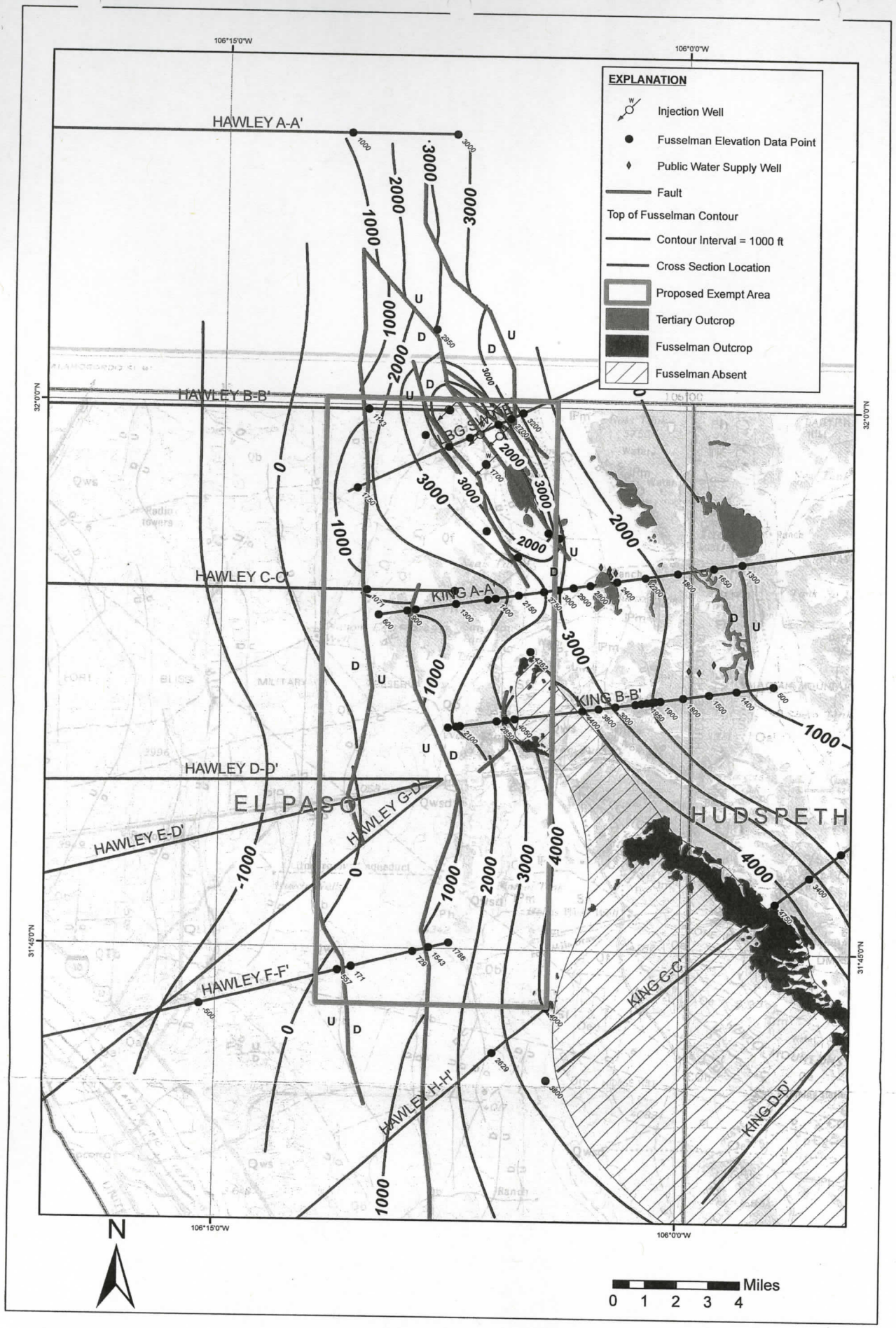


Top of Fusselman Dolomite Structure Map

Figure 17

LBG-GUYTON ASSOCIATES

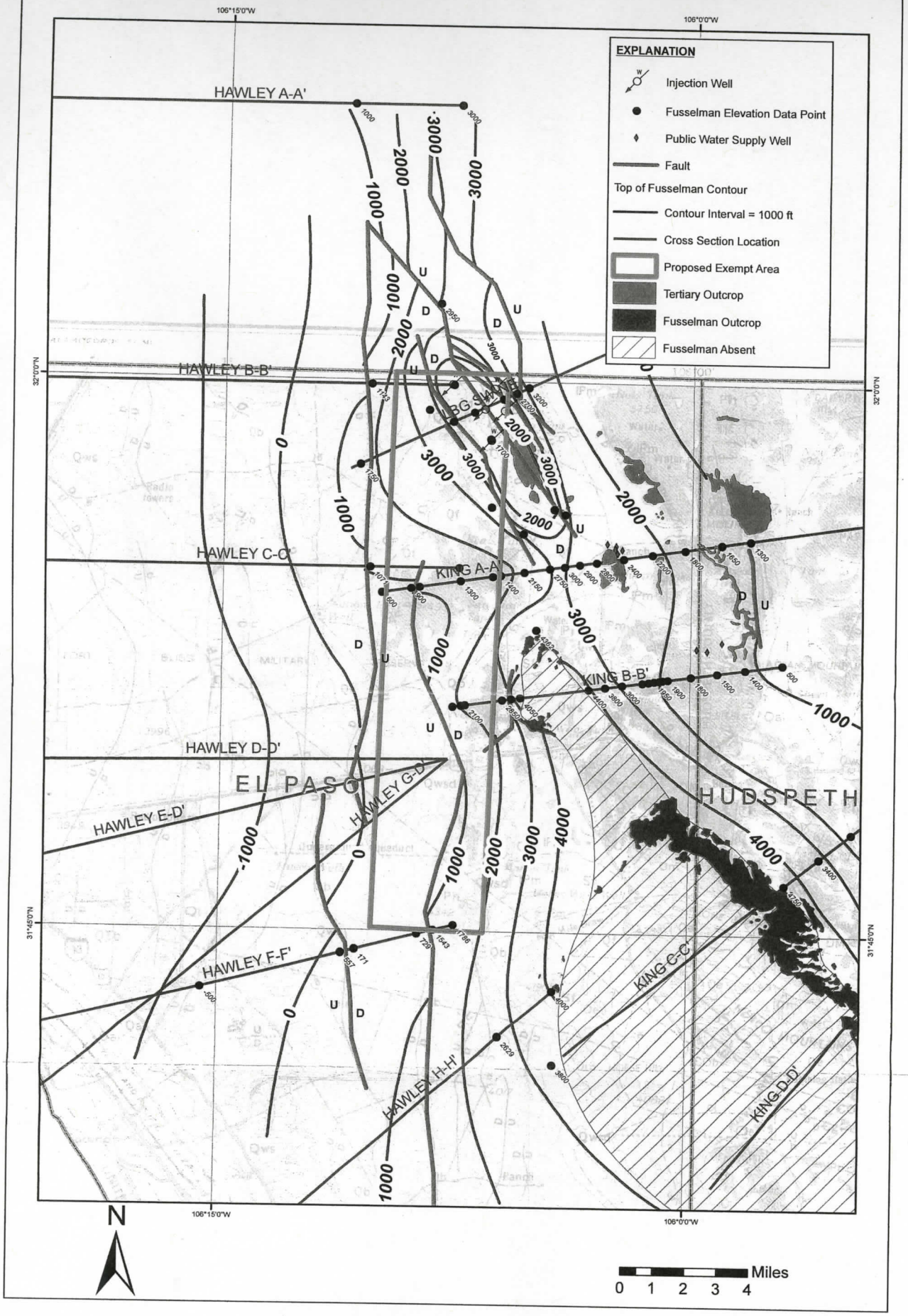
The top of the Fusselman appears to rise as high as 900' subsurface in the proposed exempted zone, This disagrees with the NARRATIVE p. 6.



Top of Fusselman Dolomite
Structure Map

Figure 17

LBG-GUYTON ASSOCIATES



Top of Fusselman Dolomite
Structure Map

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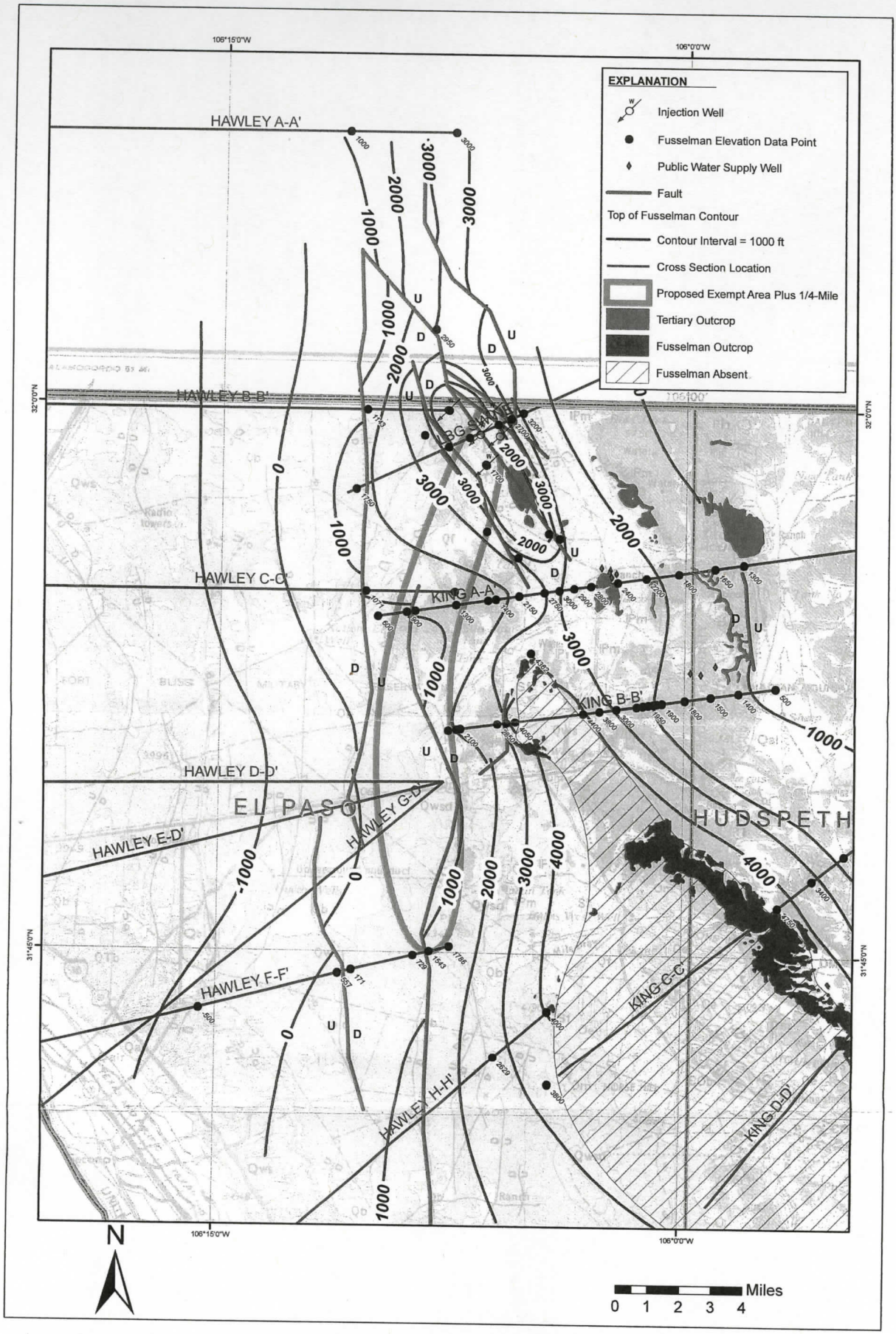

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Structure Map

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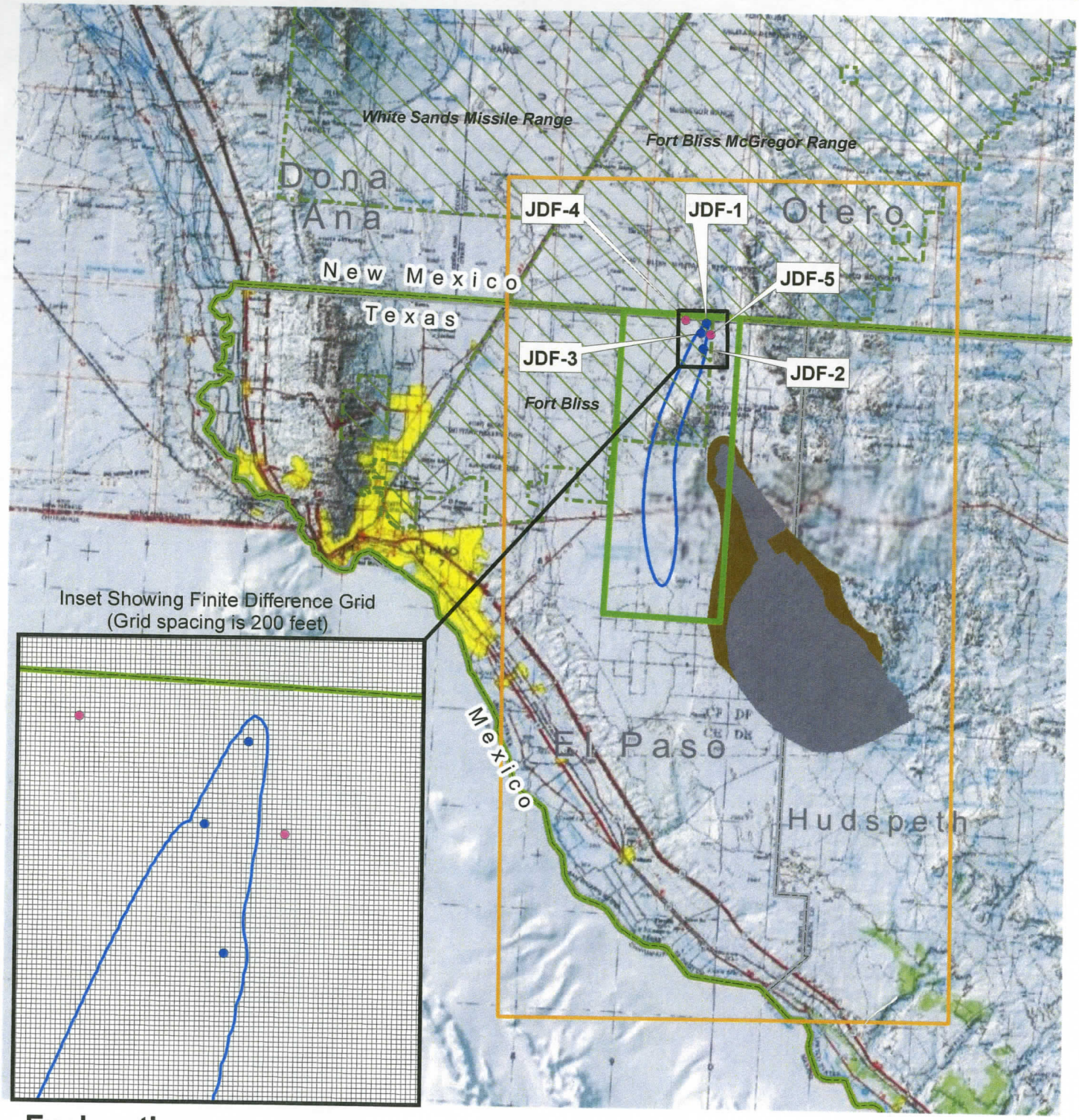
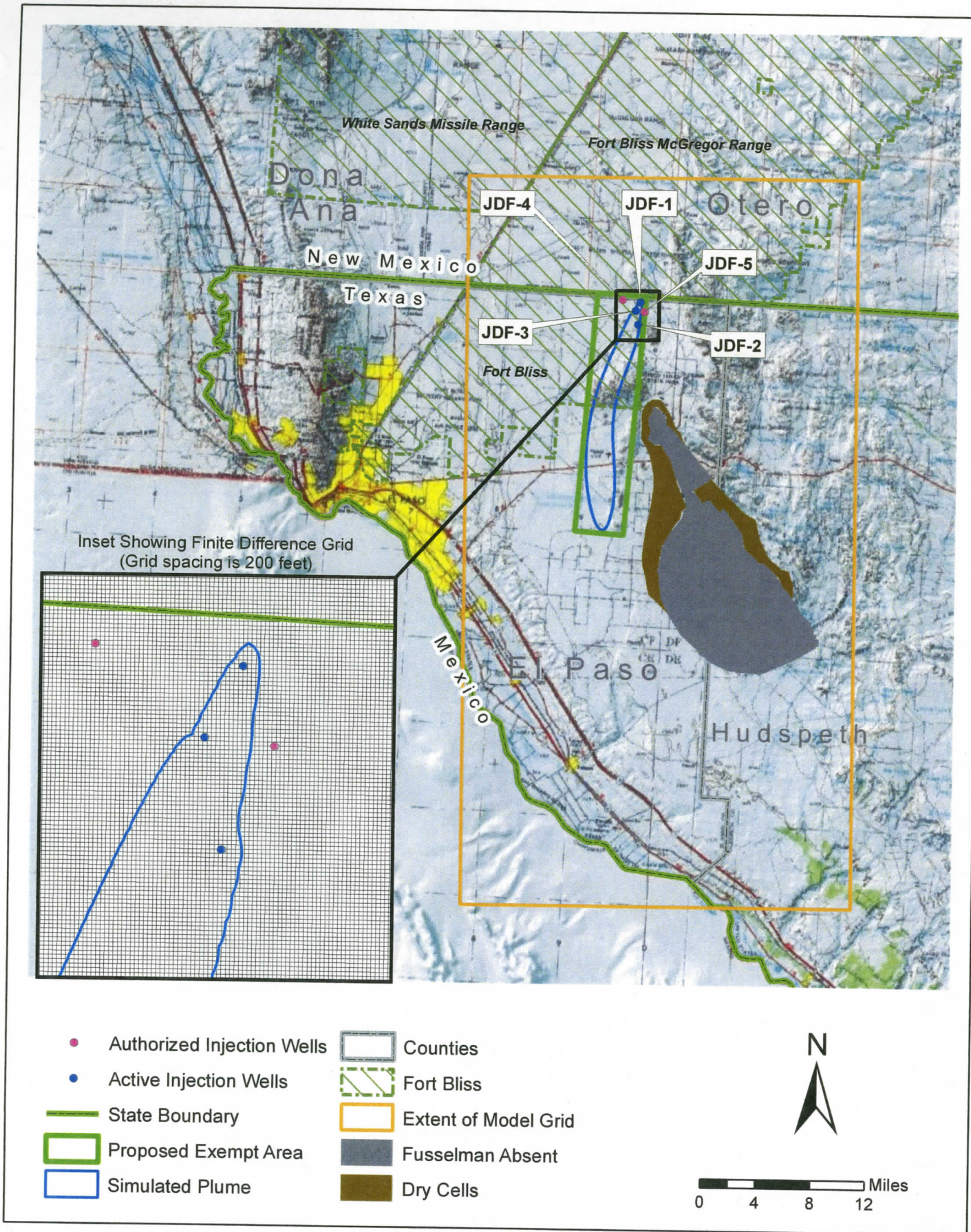


FINITE-DIFFERENCE MODEL GRID USED FOR FLOW AND TRANSPORT MODELING

FIGURE 18

LBG-GUYTON ASSOCIATES



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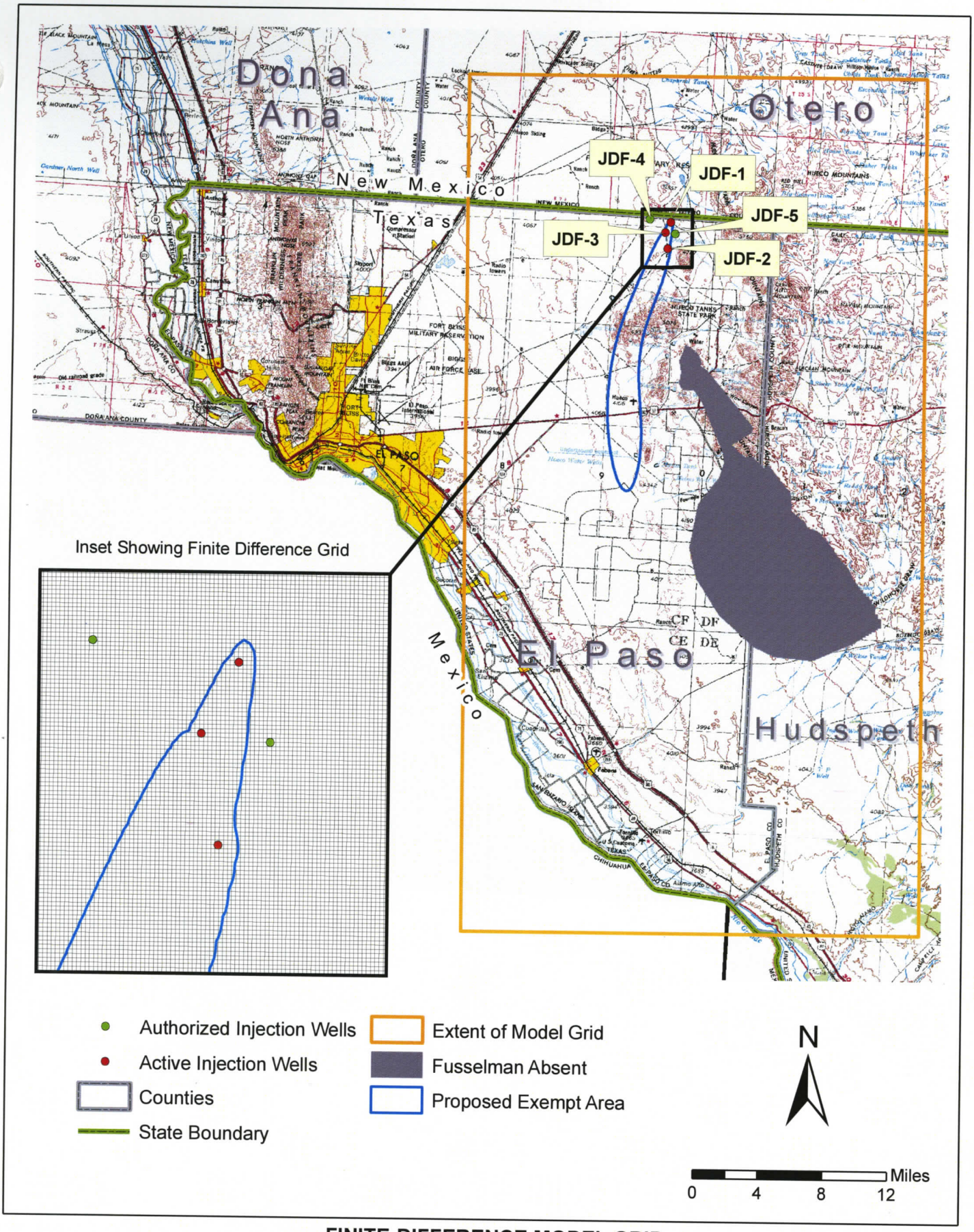

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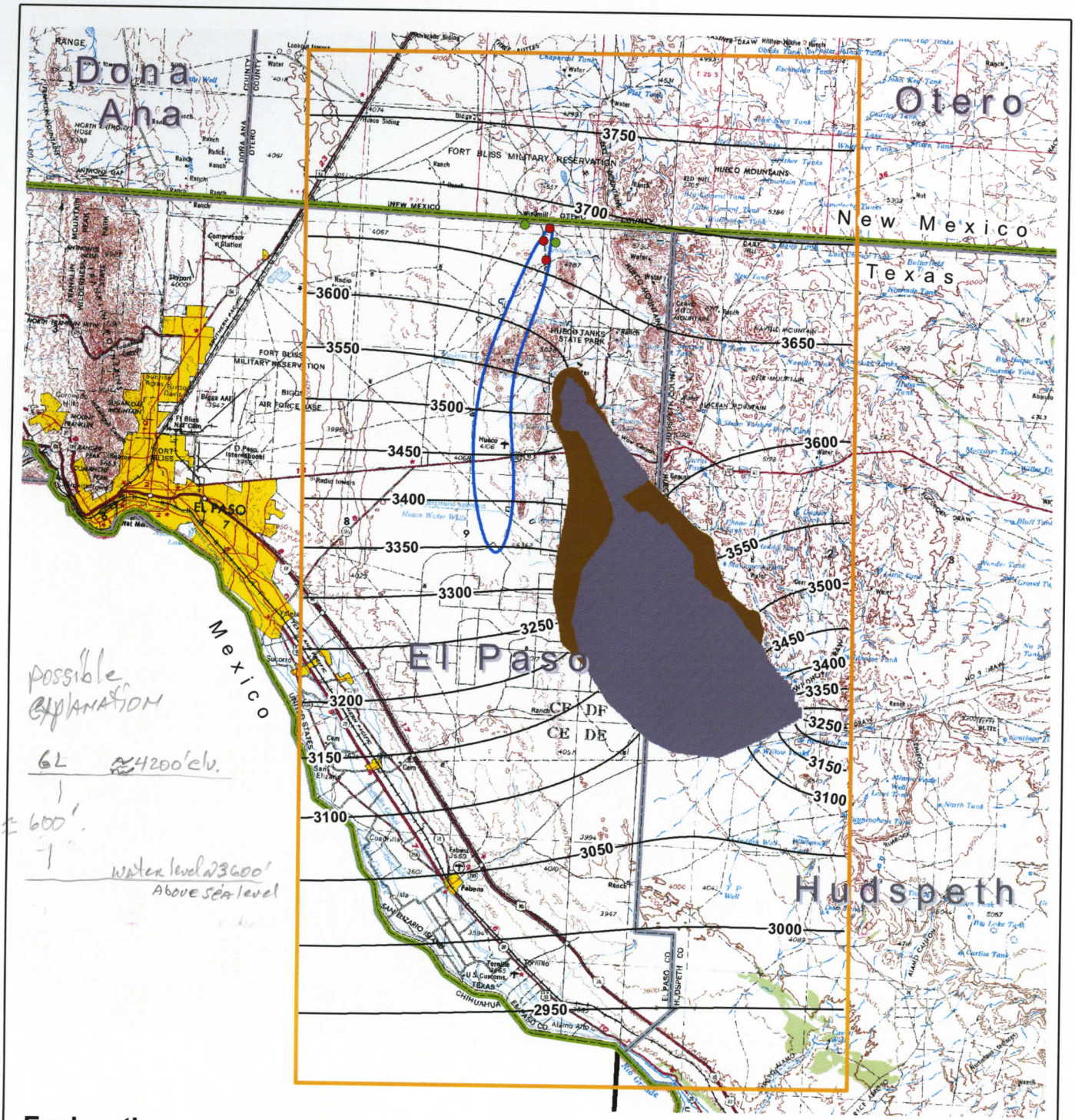


Explanation

- Active Injection Wells
- Authorized Injection Wells
- Pre-Injection Head Contours
- State Boundary
- Counties
- Extent of Model Grid
- Proposed Exempt Area
- Fusselman Absent
- Dry Cells

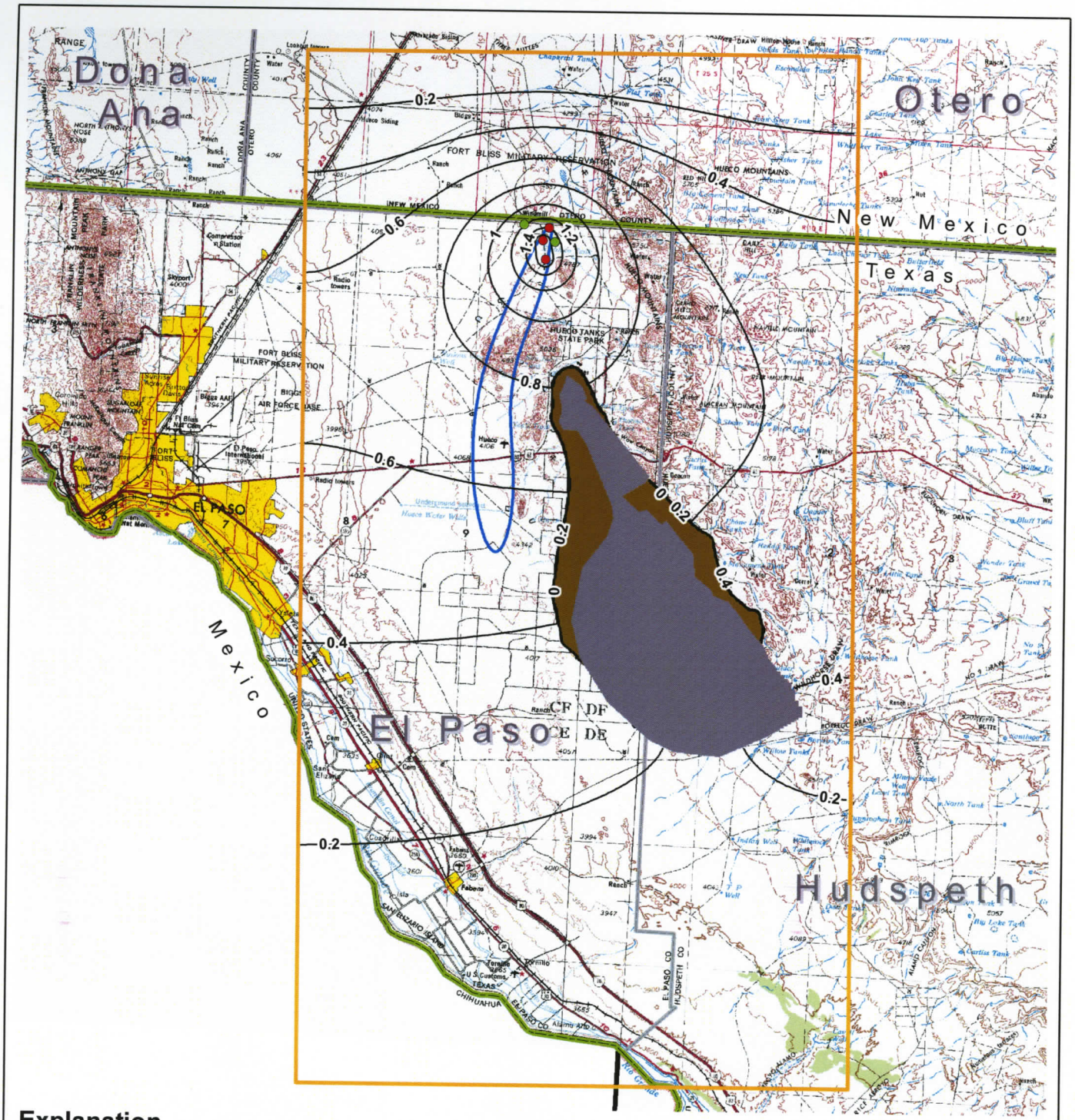
N

0 4 8 12 Miles

STEADY-STATE POTENTIOMETRIC CONTOURS IN THE AQUIFER

FIGURE 19

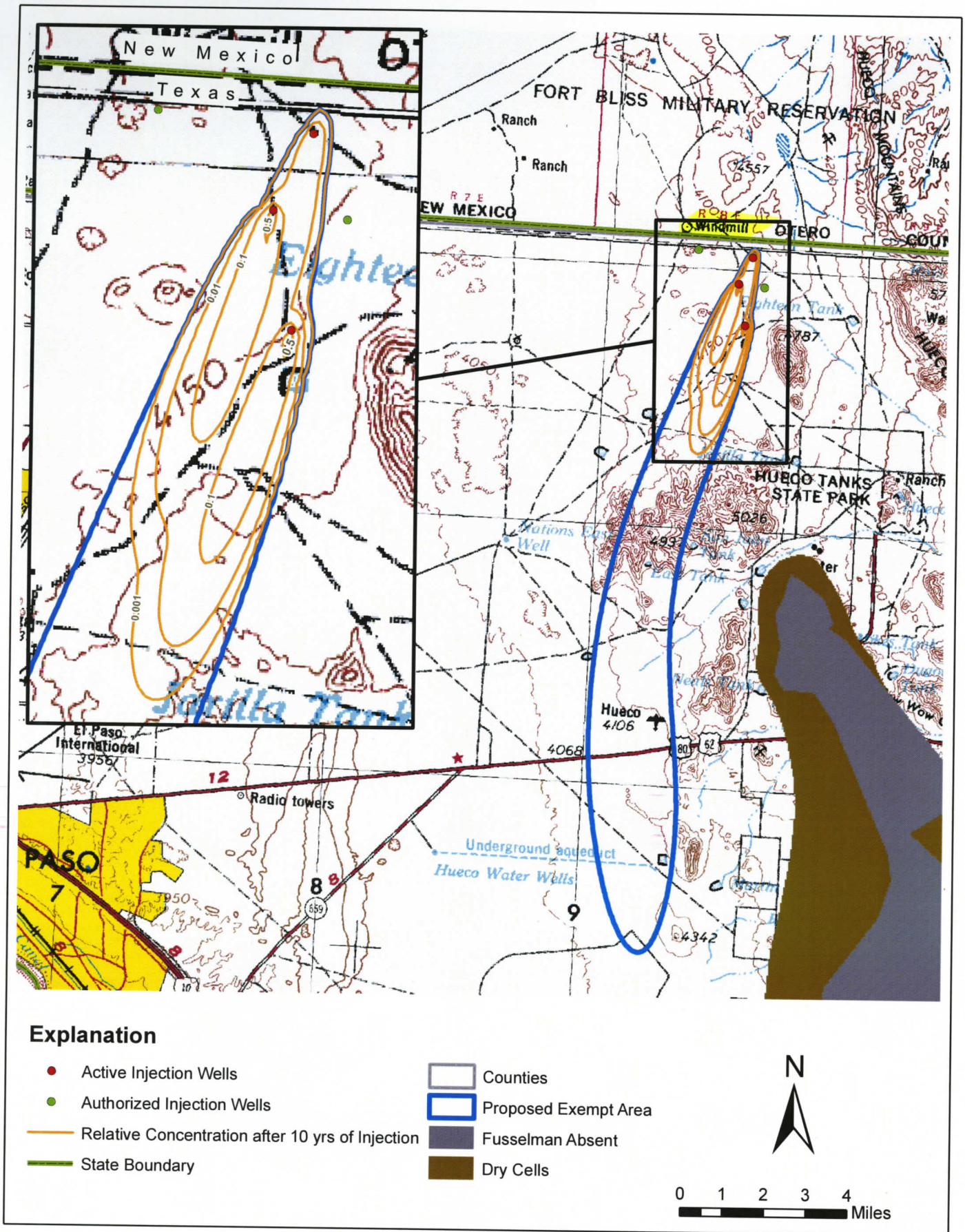
LBG-GUYTON ASSOCIATES



PRESSURE INCREASE (FEET)
AFTER 50 YEARS OF INJECTION

FIGURE 20

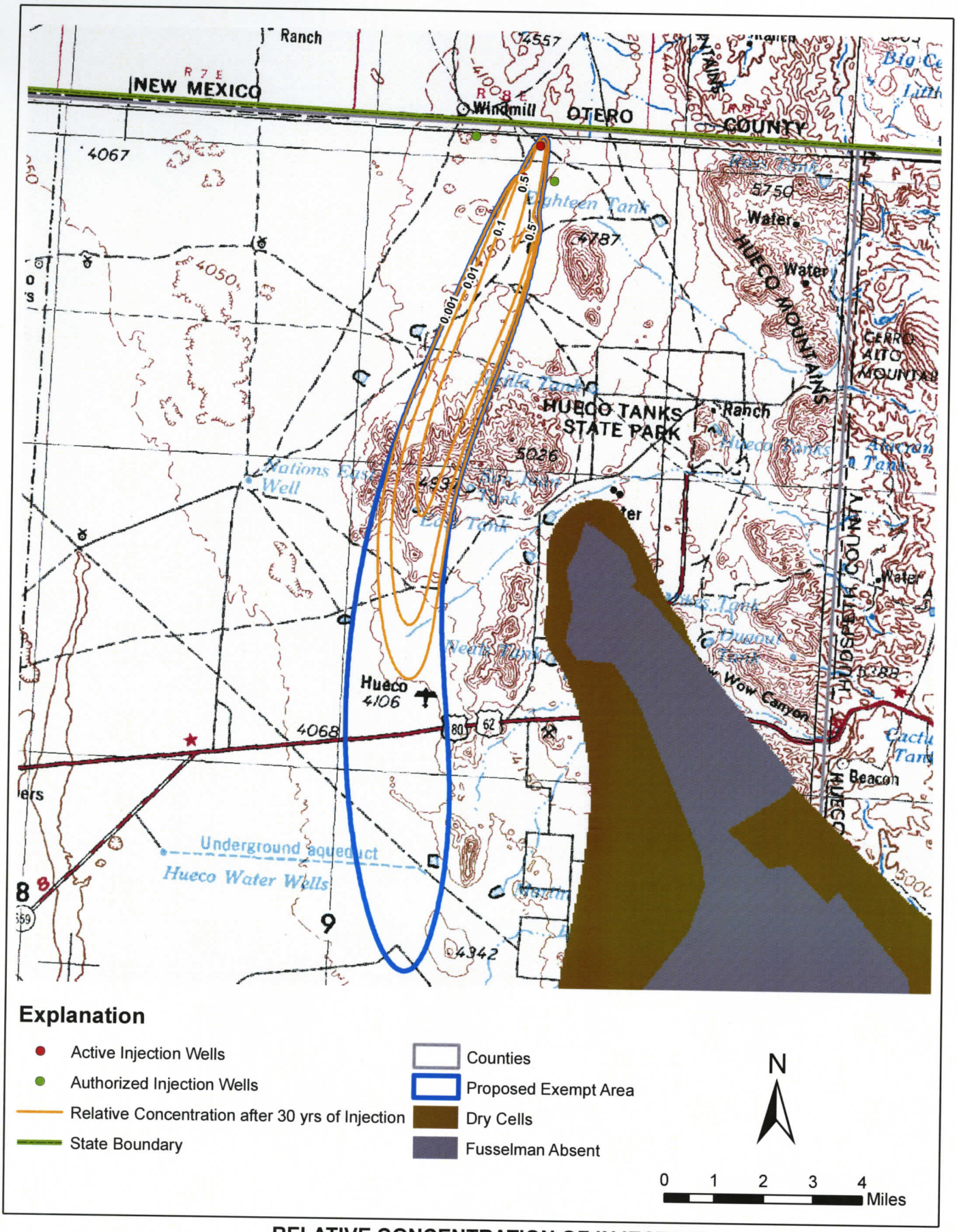
LBG-GUYTON ASSOCIATES



RELATIVE CONCENTRATION OF INJECTATE AFTER 10 YEARS OF INJECTION

FIGURE 21

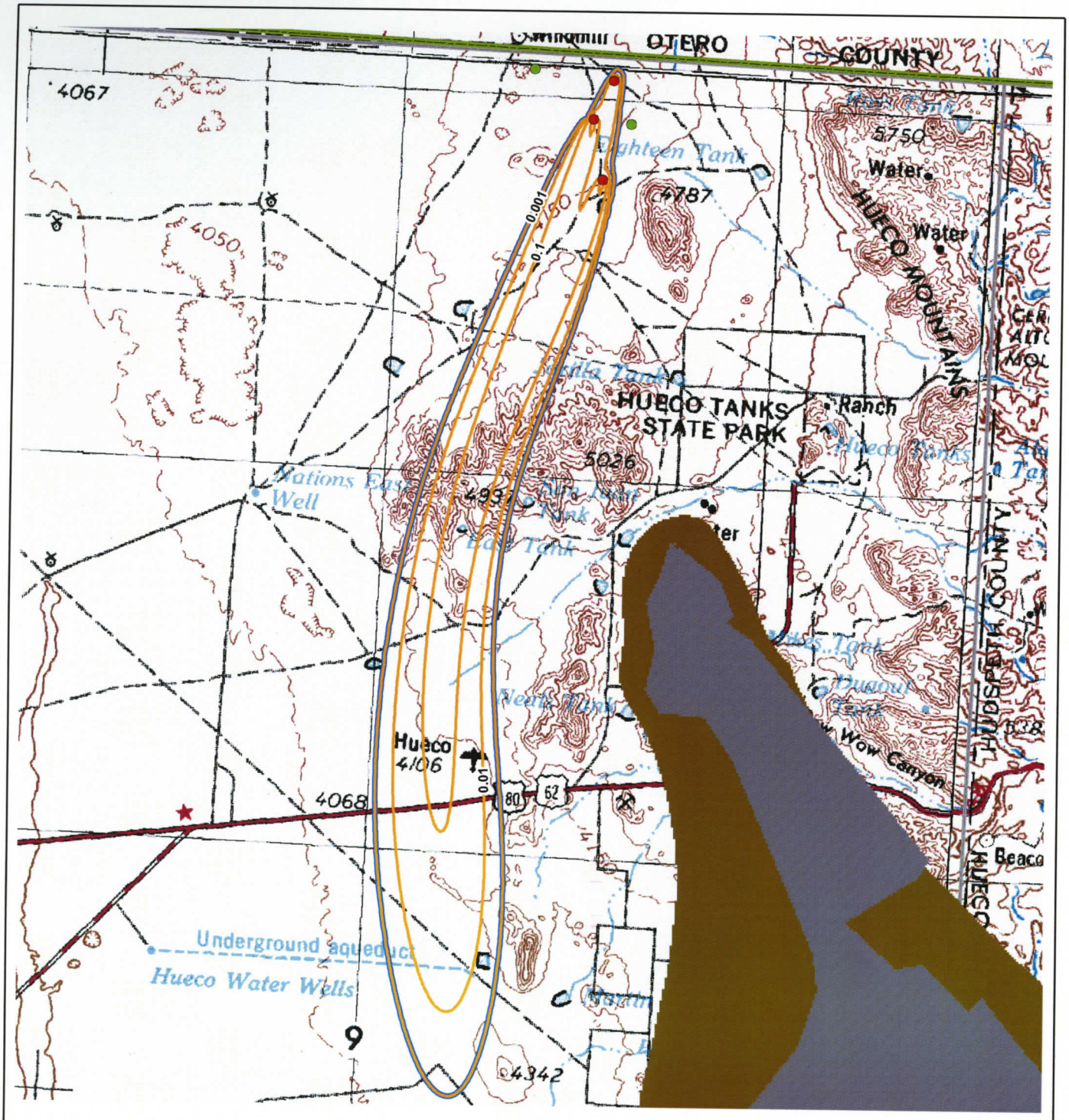
LBG-GUYTON ASSOCIATES



RELATIVE CONCENTRATION OF INJECTATE AFTER 30 YEARS OF INJECTION

FIGURE 22

LBG-GUYTON ASSOCIATES



RELATIVE CONCENTRATION OF INJECTATE AFTER 50 YEARS OF INJECTION

FIGURE 23

LBG-GUYTON ASSOCIATES

Appendix A Project Activity Timeline

Timeline of Project Activities

Date	Activity
11/1/01	Initial meeting with TCEQ to discuss permitting requirements for proposed EPWU desalination project.
3/20/02	Meeting with TCEQ to discuss permit application.
10/24/02	Meeting with the Office of Waste Management – UIC Section to discuss the procedure for permitting wells involved in the injection site testing program and the project notification requirements.
11/18/02	Meeting with the New Mexico Ground Water Quality Bureau – UIC Program to provide overview of the desal project and to inquire of potential requirements that might be imposed by the Department. Ms. Karen Menetrey (Section Head of the Ground Water Pollution Prevention Section) was given an overview of the project which included more detail on the brine injection component. After reviewing a copy of the New Mexico Water Quality Commission Regulations (20.6.2 NMAC), Ms. Menetry expressed that she did not think we would be required to comply with any of the New Mexico regulations but that she would consult with EPA Region VI and TCEQ.
3/11/03	Drilling commenced on Test Well 1. Drilling operations concluded on 8/24/03.
3/24/03	Test injection permit application was submitted to TCEQ.
4/9/03	Drilling commenced on Test Well 2. Drilling operations concluded on 5/9/03.
5/8/03	Drilling commenced on Test Well 3. Drilling operations concluded on 8/8/03.
5/15/03	TCEQ Authorization by Rule issued for the construction and operation of the injection well testing.
5/26/03	Drilling commenced on Pilot Hole 1. Drilling operations concluded on 6/7/03.
8/29/03	Coordination meeting with TCEQ to provide an overview of the project location, participants, surface and subsurface geology and hydrology, test hole results, as well as current and future project activities.
1/14/04	Meeting with TCEQ to review the injection test well design specifications.
2/3/04	Permit application amendment submitted to TCEQ due to well construction changes.
3/31/04	TCEQ grants Amendment to Authorization per 2/3/04 submittal.
6/23/04	Meeting with Ms. Karen Menetrey (NMED). A letter was provided to EPWU stating that NMED does not have jurisdiction for permitting the EPWU project.
7/28/04	Briefing with TCEQ on the current status of the pilot hole (e.g., water sampling, pumping test, etc.). Determination was made that the project would be a Class V registration/authorization process.
9/21/04	Well completion report on pilot injection well submitted to TCEQ.
10/1/04	Meeting with TCEQ focused around the Class V registration/authorization process with some Class I technical additions (Parts V-XI of Class I application).
10/26/04	Letter from TCEQ granting approval to proceed with Class V applications.

1/11/05	Meeting with TCEQ to discuss identification and description of confining units, sampling frequencies, and integrity testing.
3/8/05	Application for five Class V Injection Wells submitted to TCEQ with copy to NMED.
4/29/05	TCEQ requests additional information on injection well construction/operation and wastes/waste management.
5/9/05	Additional information submitted to TCEQ per request of 4/29/05.
6/15/05	TCEQ requests an updated table outlining parameters of concern in injectate.
6/20/05	Additional information submitted to TCEQ per request of 6/15/05.
7/13/05	Authorization by Rule issued for Class V Injections Wells.
2/27/07	Meeting with TCEQ to discuss construction status, proposed mechanical integrity testing, sampling, submittal of well completion report, and amendment of authorization to address drinking water standards concern.
6/13/07	Letter to TCEQ requesting amendment on annular pressure test for Well 2.
6/14/07	Letter to TCEQ requesting amendment to authorization addressing waste stream and injection zone water quality, temporary waste stream exceedance, mechanical integrity testing, as well as injection pressure and rate.
7/16/07	Well completion report for Well 1 submitted to TCEQ.
7/31/07	Well completion reports for Wells 2 and 3 submitted to TCEQ.
8/7/07	Meeting with TCEQ to provide project update, discuss completion reports, USDWs, and amendment of authorization.
8/8/07	Letter to TCEQ requesting continuation of system testing operations until processing of requested amendment and review of completion reports is complete.
8/23/07	Letter to TCEQ modifying EPWU request of 6/14/07.
8/27/07	Authorization from TCEQ to continue system testing operations per request of 8/8/07.
8/30/07	Request from TCEQ for additional information on well completion reports.
10/8/07	Letter from TCEQ approving request of 6/13/07 on amendment for annular pressure test for Well 2.
10/17/07	Letter from TCEQ addressing amendment requests of 6/14/07 and 8/23/07.
12/6/07	Meeting with TCEQ to provide project update, discussion of arsenic level exceedance, and how to address injecting water that exceeds primary drinking water standards even if the formation water is already above the primary standards for a particular parameter. Discussed action plans including possible Aquifer Exemption. Requested input on how to address issues of concern. TCEQ requested briefing document that outlines general issues related to aquifer exemption.
12/7/07	Letter to TCEQ notifying immediate steps had been taken to reduce arsenic levels.
12/11/07	Laboratory report submitted to TCEQ verifying arsenic concentration was in accordance with authorization. Per TCEQ's request of 12/6/07, submitted briefing document outlining issues associated with aquifer exemption.
12/12/07	Meeting with EPA to discuss issues, action plans, and opportunities on how to address injecting water that exceeds primary drinking water standards even if the formation water is already above the primary standards for a particular

	parameter. Discussed action plans including possible Aquifer Exemption. Requested input on how to address issue of concern.
12/13/07	Contacted NMED and provided an Aquifer Exemption briefing document. Requested meeting date to discuss project.
2/19/08	Met with NMED to provide overview of project and Aquifer Exemption request.
3/21/08	Contacted NMED Drinking Water Bureau (Santa Fe and Las Cruces) to identify any public water supply systems utilizing proposed exempt aquifer as source of drinking water.
3/25/08	Contacted TCEQ Public Drinking Water Program to identify any public water supply systems utilizing proposed exempt aquifer as source of drinking water.
8/21/08	Submitted Aquifer Exemption Request to TCEQ.
9/3/08	Submitted Aquifer Exemption Request to NMED.
3/31/09	Met with TCEQ to receive update on staff's review of application and answer any questions they may have.
3/31/09	Received comments back from NMED regarding Aquifer Exemption.
4/29/09	Met with TCEQ to discuss potential issues/concerns (e.g., groundwater gradient, modeling, etc.) regarding Aquifer Exemption.
6/00/09	Refined modeling data.
6/4/09	Received Technical Notice of Deficiency (NOD) No. 1 letter from TCEQ.
6/30/09	EPWU response to NOD No. 1 seeking time extension due to lab analysis turn-around time.
6/30/09	Met with NMED to discuss potential concerns on Aquifer Exemption. Discussed refined modeling data.
7/1/09	Met with TCEQ to discuss update on Aquifer Exemption application and TCEQ's correspondence of 6/4/09.
7/00/09	Refined numerical grid and decreased dispersivity in model. Based on refined modeling, plume migration into New Mexico is zero.
9/9/09	Provided TCEQ with analytical report for undiluted concentrate sample collected from desalination facility.
11/3/09	Conference call with TCEQ to discuss revised aquifer exemption application.
4/23/10	Submitted revised application to TCEQ.

Appendix B Chemical Analyses for Proposed Exempt Aquifer

EXHIBIT
Q

ASSAIGAI ANALYTICAL LABORATORIES, INC.

4301 Masthead NE • Albuquerque, New Mexico 87109 • (505) 345-8964 • FAX (505) 345-7259
3332 Wedgewood, Ste. N • El Paso, Texas 79925 • (915) 593-6000 • FAX (915) 593-7820
127 Eastgate Drive, 212-C • Los Alamos, New Mexico 87544 • (505) 662-2558

Explanation of codes	
B	analyte detected in Method Blank
E	result is estimated
H	analyzed out of hold time
N	tentatively identified compound
S	subcontracted
1-9	see footnote

UNITED DRILLING CO.
attn: JESUS SALAZAR
P.O. BOX 7698
ALBUQUERQUE NM 87194

Open Hole: 2,316 – 2,327 ft

STANDARD

Assaigai Analytical Laboratories, Inc.

Certificate of Analysis

REVISED 8/24 1:28:49

Client: UNITED DRILLING CO.
Project: JDF INJECTION TEST WELL 6/29/04
Order: 0406734 UNI01E Receipt: 06-29-04

William P. Biava: President of Assaigai Analytical Laboratories, Inc.

Sample: *INJECTION TEST WELL* Collected: *06-29-04 12:44:00* By: *JK*
Matrix: *GW*

IC Group	Run Sequence	CAS #	Analyte	Result	Units	Dilution Factor	Detection Limit	Code	Prep Date	Run Date
406734-01A		**EPA 120.1 Specific Conductance**						By: JPH		
VCOND04046	WC.2004.1974.12		Conductivity	13820	umhos/cm	1	1		07-09-04	07-09-04
406734-01A		**EPA 150.1 pH, Electometric**						By: ADG		
WPH0468	WC.2004.1976.1		pH	8.0	units	1	0.1		06-29-04	06-29-04
WPH0468	WC.2004.1976.1		sample temperature @	22.9	deg C	1	0		06-29-04	06-29-04
406734-01A		**EPA 160.1 Total Dissolved Solids**						By: JPH		
VTDS04076	WC.2004.1918.6		Total Dissolved Solids	7700	mg / L	1	10		07-01-04	07-06-04
406734-01A		**EPA 180.1 Turbidity, Nephelometric**						By: RAP		
VTURB04065	WC.2004.1885.2		Turbidity	29.7	NTU	1	0.3		07-01-04	07-01-04
406734-01A		**EPA 300.0 Anions by IC**						By: DAW		
V04460	WC.2004.1862.19		Bromide	4.66	mg / L	10	0.05		06-30-04	06-30-04
V04465	WC.2004.1907.15	16887-00-6	Chloride	4380	mg / L	500	0.05		07-01-04	07-01-04
V04460	WC.2004.1862.19	16984-48-8	Fluoride	3.11	mg / L	10	0.05		06-30-04	06-30-04
V04460	WC.2004.1862.19	14797-65-0	Nitrate, as N	ND	mg / L	10	0.05		06-30-04	06-30-04
V04460	WC.2004.1862.19	14797-55-8	Nitrite, as N	1.14	mg / L	10	0.05		06-30-04	06-30-04
V04460	WC.2004.1862.18		Sulfate	786	mg / L	100	0.05		06-30-04	06-30-04
406734-01A		**EPA 310.1 Alkalinity, Titrimetic**						By: CMS		
VALK04051	WC.2004.1961.5		Alkalinity, Bicarbonate	189	mg / L	1	2		07-08-04	07-08-04
VALK04051	WC.2004.1961.5		Alkalinity, Carbonate	ND	mg / L	1	2		07-08-04	07-08-04
V[illegible]	WC.2004.1961.5		Alkalinity, Total	189	mg / L	1	2		07-08-04	07-08-04
[illegible]734-01A		**SM 2120B**						By: KRL		
OL04043	WC.2004.1857.2		Color	125	APHA	1	5		06-30-04	06-30-04

SQLCoyote: Reports 1.1.0406250652XX *Report Date 8/23/2004 1:40:53 PM*

Assaigai Analytical Laboratories, Inc.

Certificate of Analysis

Cl: **UNITED DRILLING CO.**

Prc: **JDF INJECTION TEST WELL 6/29/04**

Order: **0406734** **UNI01E** Receipt: **06-29-04**

Sample: ***INJECTION TEST WELL*** Collected: *06-29-04 12:44:00* By: *JK*

Matrix: ***GW***

QC Group	Run Sequence	CAS #	Analyte	Result	Units	Dilution Factor	Detection Limit	Code	Prep Date	Run Date
0406734-01A		SM 2330B					By: KAB			
LANGL	WC.2004.1977.1		Langlier Saturation Index	0.92	N/A	1	0		07-09-04	07-09-04
0406734-01A		SM 2710F					By: JWB			
SPEG-04-007	WC.2004.2396.1		Specific Gravity	1.0058	N/A	1	1		08-23-04	08-23-04
SPEG-04-007	WC.2004.2396.1		Temperature	19	°C	1	1		08-23-04	08-23-04

Sample: ***INJECTION TEST WELL*** Collected: *06-29-04 12:44:00* By: *JK*

Matrix: ***GW***

NO Gross Alpha test

QC Group	Run Sequence	CAS #	Analyte	Result	Units	Dilution Factor	Detection Limit	Code	Prep Date	Run Date
0406734-02A		EPA 200.8 Metals by ICP-MS					By: BAS			
M041128	MT.2004.1456.17	7440-38-2	Arsenic, dissolved	0.0048	mg / L	1	0.0005		07-28-04	08-03-04
0406[illegible]-02A		EPA 4.1.1/200 series AA-FL					By: KDW			
M[illegible]	MT.2004.1259.27	7440-23-5	Sodium, dissolved	2260	mg / L	1000	1		07-06-04	07-07-0[illegible]
0406734-02A		EPA 4.1.1/200.7 ICP					By: KDW			
M04998	MT.2004.1355.70	7440-70-2	Calcium, dissolved	272	mg / L	10	0.4		07-06-04	07-19-04
M04998	MT.2004.1262.35	7439-89-6	Iron, dissolved	ND	mg / L	10	0.05		07-06-04	07-07-04
M04998	MT.2004.1262.35	7439-95-4	Magnesium, dissolved	53.9	mg / L	10	0.1		07-06-04	07-07-04
M04998	MT.2004.1262.35	7439-96-5	Manganese, dissolved	ND	mg / L	10	0.01		07-06-04	07-07-04
M04998	MT.2004.1355.70	7440-09-7	Potassium, dissolved	111	mg / L	10	0.2	E	07-06-04	07-19-04
M04998	MT.2004.1355.70	7440-21-3	Silicon, dissolved	16.1	mg / L	10	0.1	E	07-06-04	07-19-04

Sample: ***INJECTION TEST WELL*** Collected: *06-29-04 12:44:00* By: *JK*

Matrix: ***GW***

QC Group	Run Sequence	CAS #	Analyte	Result	Units	Dilution Factor	Detection Limit	Code	Prep Date	Run Date
0406734-03A		EPA 200.8 Metals by ICP-MS					By: BAS			
M041130	MT.2004.1456.45	7440-38-2	Arsenic	0.006	mg / L	1	0.001		07-28-04	08-03-04
0406734-03A		EPA 4.1.3/200 series AA-FL					By: KDW			
M04980	MT.2004.1259.17	7440-23-5	Sodium	2800	mg / L	500	1		07-01-04	07-07-04
0406734-03A		EPA 4.1.3/200.7 ICP					By: KDW			
M04980	MT.2004.1249.19	7440-70-2	Calcium	282	mg / L	10	0.4		07-01-04	07-02-04
M04980	MT.2004.1249.19	7439-89-6	Iron	4.40	mg / L	10	0.05		07-01-04	07-02-04
M04980	MT.2004.1249.19	7439-95-4	Magnesium	59.8	mg / L	10	0.1		07-01-04	07-02-04
M04980	MT.2004.1249.19	7439-96-5	Manganese	ND	mg / L	10	0.01		07-01-04	07-02-04
M[illegible]	MT.2004.1261.25	7440-09-7	Potassium	116	mg / L	10	2.5		07-01-04	07-07-04
M.	MT.2004.1354.60	7440-21-3	Silicon	19.1	mg / L	10	0.4	E	07-01-04	07-19-[illegible]

Assaigai Analytical Laboratories, Inc.

Certificate of Analysis

UNITED DRILLING CO.

JDF INJECTION TEST WELL 6/29/04

0406734 UNI01E Receipt: **06-29-04**

INJECTION TEST WELL Collected: *06-29-04 12:44:00* By: *JK*

GW

C Group	Run Sequence	CAS #	Analyte	Result	Units	Dilution Factor	Detection Limit	Code	Prep Date	Run Date
406734-03A		SM 2340B					By: KAB			
ARD	MT.2004.1286.1		Hardness, as CaCO3	950	mg / L	1	0		07-09-04	07-09-04

Unless otherwise noted, all samples were received in acceptable condition and all sampling was performed by client or client representative. Sample result of ND indicates Not Detected, ie result is less than the sample specific Detection Limit. Sample specific Detection Limit is determined by multiplying the sample Dilution Factor by the listed Reporting Detection Limit. All results relate only to the items tested. Any miscellaneous workorder information or foonotes will appear below.

MEMO: Pursuant to Standard Methods Figure 4500-CO2 for Free Carbon Dioxide, the Total Dissolved Solids and Bicarbonate Alkalinity parameters utilized for the calculation are above the nomograph scale. Therefore, one can assume that the Free Carbon Dioxide in this sample is greater than 2000 mg/L.

P-Alkalinity is non-detected (ND) as the pH of the sample is less than 8.3 pH units.

EXHIBIT
R

ASSAIGAI ANALYTICAL LABORATORIES, INC.

4301 Masthead NE • Albuquerque, New Mexico 87109 • (505) 345-8964 • FAX (505) 345-7259
3332 Wedgewood, Ste. N • El Paso, Texas 79925 • (915) 593-6000 • FAX (915) 593-7820
127 Eastgate Drive, 212-C • Los Alamos, New Mexico 87544 • (505) 662-2558

Explanation of codes	
B	analyte detected in Method Blank
E	result is estimated
H	analyzed out of hold time
N	tentatively identified compound
S	subcontracted
1-9	see footnote

UNITED DRILLING CO.
attn: JESUS SALAZAR
P.O. BOX 7698
ALBUQUERQUE NM 87194

Open Hole: 2,316 – 2,685 ft
must be different well

STANDARD

Assaigai Analytical Laboratories, Inc.

Certificate of Analysis

REVISED
8/10/4 8:59:14

Client: UNITED DRILLING CO.
Project: JDF INJECTION TEST WELL
Order: 0407087 UNI01E Receipt: 07-06-04

William P. Biava: President of Assaigai Analytical Laboratories, Inc.

Sample: *JDF INJECT #2* Collected: *07-02-04 23:25:00* By:
Matrix: *GRAB*

QC Group	Run Sequence	CAS #	Analyte	Result	Units	Dilution Factor	Detection Limit	Code	Prep Date	Run Date
I407087-01A			**EPA 120.1 Specific Conductance**					By: JPH		
VCOND04046	WC.2004.1974.11		Conductivity	12690	umhos/cm	1	1		07-09-04	07-09-04
I407087-01A			**EPA 150.1 pH, Electometric**					By: KRL		
VPH04100	WC.2004.1959.3		pH	7.7	units	1	0.1	H	07-07-04	07-07-04
VPH04100	WC.2004.1959.3		sample temperature @	16.6	deg C	1	0		07-07-04	07-07-04
I407087-01A			**EPA 160.1 Total Dissolved Solids**					By: JPH		
VTDS-04-079	WC.2004.1970.8		Total Dissolved Solids	6940	mg/L	1	10		07-07-04	07-08-04
I407087-01A			**EPA 180.1 Turbidity, Nephelometric**					By: RAP		
VTURB04066	WC.2004.1948.2		Turbidity	26.9	NTU	1	0.3	H	07-07-04	07-07-04
I407087-01A			**EPA 300.0 Anions by IC**					By: DAW		
V04483	WC.2004.1952.21		Bromide	4.38	mg / L	10	0.05		07-07-04	07-07-04
V04489	WC.2004.1986.21	16887-00-6	Chloride	3700	mg / L	200	0.05		07-09-04	07-09-04
V04483	WC.2004.1952.21	16984-48-8	Fluoride	2.85	mg / L	10	0.05		07-07-04	07-07-04
V04483	WC.2004.1952.21	14797-65-0	Nitrate, as N	ND	mg / L	10	0.05	H	07-07-04	07-07-04
V04483	WC.2004.1952.21	14797-55-8	Nitrite, as N	1.22	mg / L	10	0.05	H	07-07-04	07-07-04
V04483	WC.2004.1952.20		Sulfate	643	mg / L	100	0.05		07-07-04	07-07-04
I407087-01A			**EPA 310.1 Alkalinity, Titrimetic**					By: CMS		
VALK04051	WC.2004.1961.10		Alkalinity, Bicarbonate	253	mg / L	1	2		07-08-04	07-08-04
VALK04051	WC.2004.1961.10		Alkalinity, Carbonate	ND	mg / L	1	2		07-08-04	07-08-04
VA[illegible]1	WC.2004.1961.10		Alkalinity, Total	253	mg / L	1	2		07-08-04	07-08-04
[illegible]087-01A			**SM 2120B**					By: KRL		
[illegible]O04044	WC.2004.1966.2		Color	100	APHA	1	5	H	07-08-04	07-08-04

SQLCoyote: Reports 1.1.0406250652XX Report Date 8/23/2004 1:42:21 PM

Assaigai Analytical Laboratories, Inc.

Certificate of Analysis

Cl: **UNITED DRILLING CO.**

Pro: **JDF INJECTION TEST WELL**

Order: **0407087** **UNI01E** Receipt: **07-06-04**

Sample: ***JDF INJECT #2*** Collected: *07-02-04 23:25:00* By:

Matrix: ***GRAB***

QC Group	Run Sequence	CAS #	Analyte	Result	Units	Dilution Factor	Detection Limit	Code	Prep Date	Run Date
0407087-01A		**SM 2330B**						By: LBL		
LANG	WC.2004.2065.1		Langliers Saturation Index	0.71	N/A	1	0		07-20-04	07-20-04
0407087-01A		**SM 2710F**						By: JWB		
SPEG-04-007	WC.2004.2396.2		Specific Gravity	1.0052	N/A	1	1		08-23-04	08-23-04
SPEG-04-007	WC.2004.2396.2		Temperature	19	°C	1	1		08-23-04	08-23-04
0407087-01B		**EPA 900**						By: JF		
ARS041180	SB.2004.384.1		Gross Alpha	412.2+/- 56.721	pCi/L	1	24.201	S	07-19-04	07-19-04
ARS041180	SB.2004.384.1		Gross Beta	161.7+/- 17.735	pCi/L	1	17.085	S	07-19-04	07-19-04

Sample: ***JDF INJECT #2*** Collected: *07-02-04 23:20:00* By:

Matrix: ***GRAB***

QC Group	Run Sequence	CAS #	Analyte	Result	Units	Dilution Factor	Detection Limit	Code	Prep Date	Run Date
0407087-03A		**EPA 200.8 Metals by ICP-MS**						By: BAS		
M041129	MT.2004.1456.29	7440-38-2	Arsenic	0.0106	mg / L	1	0.0005		07-28-04	08-03-04
0407087-03A		**EPA 4.1.3/200.7 ICP**						By: KDW		
M041006	MT.2004.1329.53	7440-70-2	Calcium	307	mg / L	10	0.1		07-08-04	07-15-04
M041006	MT.2004.1329.53	7439-89-6	Iron	2.28	mg / L	10	0.07		07-08-04	07-15-04
M041006	MT.2004.1329.53	7439-95-4	Magnesium	60.4	mg / L	10	0.6		07-08-04	07-15-04
M041006	MT.2004.1329.53	7439-96-5	Manganese	ND	mg / L	10	0.02		07-08-04	07-15-04
M041006	MT.2004.1329.53	7440-09-7	Potassium	111	mg / L	10	2.5		07-08-04	07-15-04
M041006	MT.2004.1364.36	7440-21-3	Silicon	17.9	mg / L	10	0.4	E	07-08-04	07-20-04
M041006	MT.2004.1329.53	7440-23-5	Sodium	2180	mg / L	10	0.2		07-08-04	07-15-04
0407087-03A		**HARDHARD**						By: LBL		
HARD	MT.2004.1357.2		Hardness as CaCO3	1020	mg / L	1	0		07-20-04	07-20-04
0407087-03B		**EPA 200.8 Metals by ICP-MS**						By: BAS		
M041128	MT.2004.1456.18	7440-38-2	Arsenic, dissolved	0.0034	mg / L	1	0.0005		07-28-04	08-03-04
0407087-03B		**EPA 4.1.1/200.7 ICP**						By: KDW		
M041061	MT.2004.1391.19	7440-70-2	Calcium, dissolved	293	mg / L	11	0.4		07-15-04	07-24-04
M041061	MT.2004.1391.19	7439-89-6	Iron, dissolved	ND	mg / L	11	0.05		07-15-04	07-24-04
M041061	MT.2004.1391.19	7439-95-4	Magnesium, dissolved	59.2	mg / L	11	0.1		07-15-04	07-24-04
M041061	MT.2004.1391.19	7439-96-5	Manganese, dissolved	ND	mg / L	11	0.01		07-15-04	07-24-04
M041061	MT.2004.1391.19	7440-09-7	Potassium, dissolved	105	mg / L	11	0.2		07-15-04	07-24-04
M041061	MT.2004.1407.19	7440-21-3	Silicon, dissolved	5.4	mg / L	11	0.1	E	07-15-04	07-26-04
M041061	MT.2004.1407.19	7440-23-5	Sodium, dissolved	433	mg / L	11	0.2		07-15-04	07-26-04

Assaigai Analytical Laboratories, Inc.

Certificate of Analysis

Cli-- **UNITED DRILLING CO.**

Pr **JDF INJECTION TEST WELL**

Order: **0407087** **UNI01E** Receipt: **07-06-04**

Unless otherwise noted, all samples were received in acceptable condition and all sampling was performed by client or client representative. Sample result of ND indicates Not Detected, ie result is less than the sample specific Detection Limit. Sample specific Detection Limit is determined by multiplying the sample Dilution Factor by the listed Reporting Detection Limit. All results relate only to the items tested. Any miscellaneous workorder information or foonotes will appear below.

MEMO: Pursuant to Standard Methods Figure 4500-CO2 for Free Carbon Dioxide, the Total Dissolved Solids and Bicarbonate Alkalinity parameters utilized for the calculation are above the nomograph scale. Therefore, one can assume that the Free Carbon Dioxide in this sample is greater than 2000 mg/L.

Radiologicals were subcontracted to American Radiation Services, Inc.

P-Alkalinity is non-detected (ND) as the pH of the sample is less than 8.3 pH units.

EXHIBIT
S

ASSAIGAI ANALYTICAL LABORATORIES, INC.

4301 Masthead NE • Albuquerque, New Mexico 87109 • (505) 345-8964 • FAX (505) 345-7259
3332 Wedgewood, Ste. N • El Paso, Texas 79925 • (915) 593-6000 • FAX (915) 593-7820
127 Eastgate Drive, 212-C • Los Alamos, New Mexico 87544 • (505) 662-2558

Explanation of codes	
B	analyte detected in Method Blank
E	result is estimated
H	analyzed out of hold time
N	tentatively identified compound
S	subcontracted
1-9	see footnote

UNITED DRILLING CO.
attn: JESUS SALAZAR
P.O. BOX 7698
ALBUQUERQUE NM 87194

Open Hole: 2,316 – 3,777 ft

Assaigai Analytical Laboratories, Inc.

Certificate of Analysis

REVISED
8/10/04 9:09:43 AM

STANDARD

William P. Biava: President of Assaigai Analytical Laboratories, Inc.

Client: UNITED DRILLING CO.
Project: JDF INJECTION 7/11/04
Order: 0407244 UNI01E Receipt: 07-13-04

Sample: *INJECTION TEST WELL* Collected: *07-11-04 19:02:00* By: *JK*
Matrix: *GW*

QC Group	Run Sequence	CAS #	Analyte	Result	Units	Dilution Factor	Detection Limit	Code	Prep Date	Run Date
0407244-01A			**EPA 120.1 Specific Conductance**					By: JPH		
VCOND04047	WC.2004.2052.4		Conductivity	14600	umhos/cm	1	1		07-16-04	07-16-04
0407244-01A			**EPA 160.1 Total Dissolved Solids**					By: JPH		
VTDS-04-096	WC.2004.2268.9		Total Dissolved Solids	8260	mg/L	1	10	H	08-05-04	08-06-04
0407244-01A			**EPA 180.1 Turbidity, Nephelometric**					By: RAP		
VTURB04069	WC.2004.2036.2		Turbidity	39.4	NTU	1	0.3	H	07-16-04	07-16-04
0407244-01A			**EPA 300.0 Anions by IC**					By: DAW		
V04501	WC.2004.2042.11		Bromide	5.08	mg / L	10	0.05		07-14-04	07-14-04
V04516	WC.2004.2082.19	16887-00-6	Chloride	4480	mg / L	500	0.05		07-20-04	07-20-04
V04501	WC.2004.2042.11	16984-48-8	Fluoride	3.16	mg / L	10	0.05		07-14-04	07-14-04
V04501	WC.2004.2042.11	14797-65-0	Nitrate, as N	ND	mg / L	10	0.05	H	07-14-04	07-14-04
V04501	WC.2004.2042.11	14797-55-8	Nitrite, as N	1.17	mg / L	10	0.05	H	07-14-04	07-14-04
V04501	WC.2004.2042.10		Sulfate	865	mg / L	100	0.05		07-14-04	07-14-04
0407244-01A			**EPA 310.1 Alkalinity, Titrimetic**					By: CMS		
VALK04053	WC.2004.2071.2		Alkalinity, Bicarbonate	268	mg / L	1	2		07-20-04	07-20-04
VALK04053	WC.2004.2071.2		Alkalinity, Carbonate	ND	mg / L	1	2		07-20-04	07-20-04
VALK04053	WC.2004.2071.2		Alkalinity, Total	268	mg / L	1	2		07-20-04	07-20-04
0407244-01A			**SM 2120B**					By: KRL		
VOL04046	WC.2004.2015.4		Color	100	APHA	1	5	H	07-14-04	07-14-04
01A			**SM 2330B**					By: MVR		
L	WC.2004.2176.1		Langlier Saturation Index	1.22	N/A	1	0		07-30-04	07-30-04

SQLCoyote: Reports 1.1.0406250652XX Report Date 8/23/2004 1:43:10 PM

STANDARD

Assaigai Analytical Laboratories, Inc.

Certificate of Analysis

Cl: **UNITED DRILLING CO.**

Project: **JDF INJECTION 7/11/04**

Order: **0407244** **UNI01E** Receipt: **07-13-04**

Sample: ***INJECTION TEST WELL*** Collected: *07-11-04 19:02:00* By: *JK*

Matrix: ***GW***

QC Group	Run Sequence	CAS #	Analyte	Result	Units	Dilution Factor	Detection Limit	Code	Prep Date	Run Date
0407244-01A		**SM 2710F**						By: JWB		
SPEG-04-007	WC.2004.2396.4		Specific Gravity	1.0060	N/A	1	1		08-23-04	08-23-04
SPEG-04-007	WC.2004.2396.4		Temperature	19	°C	1	1		08-23-04	08-23-04
0407244-01B		**EPA 200.8 Metals by ICP-MS**						By: BAS		
A041129	MT.2004.1456.30	7440-38-2	Arsenic	ND	mg / L	1	0.0005		07-28-04	08-03-04
0407244-01B		**EPA 4.1.3/200.7 ICP**						By: KDW		
A041068	MT.2004.1409.57	7440-70-2	Calcium	364	mg / L	10	0.1		07-16-04	07-26-04
A041068	MT.2004.1398.71	7439-89-6	Iron	2.97	mg / L	1	0.05		07-16-04	07-24-04
A041068	MT.2004.1409.57	7439-95-4	Magnesium	79.4	mg / L	10	0.6		07-16-04	07-26-04
A041068	MT.2004.1398.71	7439-96-5	Manganese	0.56	mg / L	1	0.01		07-16-04	07-24-04
A041068	MT.2004.1409.57	7440-09-7	Potassium	140	mg / L	10	2.5		07-16-04	07-26-04
A041068	MT.2004.1409.57	7440-21-3	Silicon	17.4	mg / L	10	0.4	E	07-16-04	07-26-04
A041068	MT.2004.1424.29	7440-23-5	Sodium	2750	mg / L	100	0.2		07-16-04	07-27-04
0407244-01B		**SM 2340B**						By: MVR		
A	MT.2004.1442.1		Hardness, as CaCO3	1240	mg / L	1	0		07-30-04	07-30-04
0407244-01D		**EPA 200.8 Metals by ICP-MS**						By: BAS		
A041128	MT.2004.1456.19	7440-38-2	Arsenic, dissolved	ND	mg / L	1	0.0005		07-28-04	08-03-04
0407244-01D		**EPA 4.1.1/200.7 ICP**						By: KDW		
A041061	MT.2004.1391.14	7440-70-2	Calcium, dissolved	368	mg / L	11	0.4		07-15-04	07-24-04
A041061	MT.2004.1391.14	7439-89-6	Iron, dissolved	ND	mg / L	11	0.05		07-15-04	07-24-04
A041061	MT.2004.1391.14	7439-95-4	Magnesium, dissolved	79.4	mg / L	11	0.1		07-15-04	07-24-04
A041061	MT.2004.1391.14	7439-96-5	Manganese, dissolved	0.43	mg / L	11	0.01		07-15-04	07-24-04
A041061	MT.2004.1391.14	7440-09-7	Potassium, dissolved	126	mg / L	11	0.2		07-15-04	07-24-04
A041061	MT.2004.1407.14	7440-21-3	Silicon, dissolved	29.5	mg / L	108	0.1	E	07-15-04	07-26-04
A041061	MT.2004.1407.14	7440-23-5	Sodium, dissolved	2520	mg / L	108	0.2		07-15-04	07-26-04
0407244-01E		**EPA 150.1 pH, Electometric**						By: AG		
EWPH0472	WC.2004.2007.1		pH	8.0	units	1	0.1	H	07-13-04	07-13-04
EWPH0472	WC.2004.2007.1		sample temperature @	25.8	deg C	1	0		07-13-04	07-13-04

Unless otherwise noted, all samples were received in acceptable condition and all sampling was performed by client or client representative. Sample result of ND indicates Not Detected, ie result is less than the sample specific Detection Limit. Sample specific Detection Limit is determined by multiplying the sample Dilution Factor by the listed Reporting Detection Limit. All results relate only to the items tested. Any miscellaneous workorder information or foonotes will appear below.

MEMO: Pursuant to Standard Methods Figure 4500-CO2 for Free Carbon Dioxide, the Total Dissolved Solids and Bicarbonate Alkalinity parameters utilized for the calculation are above the nomograph scale. Therefore, one can assume that the Free Carbon Dioxide in this sample is greater than 2000 mg/L.

P-Alkalinity is non-detected (ND) as the pH of the sample is less than 8.3 pH units.

EXHIBIT
W

ASSAIGAI ANALYTICAL LABORATORIES, INC.

4301 Masthead NE • Albuquerque, New Mexico 87109 • (505) 345-8964 • FAX (505) 345-7259
3332 Wedgewood, Ste. N • El Paso, Texas 79925 • (915) 593-6000 • FAX (915) 593-7820
127 Eastgate Drive, 212-C • Los Alamos, New Mexico 87544 • (505) 662-2558

Explanation of codes

B	analyte detected in Method Blank
E	result is estimated
H	analyzed out of hold time
N	tentatively identified compound
S	subcontracted
1-9	see footnote

UNITED DRILLING CO.
attn: **JESUS SALAZAR**
P.O. BOX 7698
ALBUQUERQUE NM 87194

Open Hole: 2,316 3,777 ft

STANDARD

Assaigai Analytical Laboratories, Inc.

Certificate of Analysis

8/13/4 1:55:31

Client: **UNITED DRILLING CO.**
Project: **JDF INJECTION**
Order: **0407588 UNI01E** Receipt: **07-27-04**

William P. Biava President of Assaigai Analytical Laboratories, Inc

Sample: ***INJECTION TEST WELL- GAS*** Collected: *07-26-04 20:05:00* By:
Matrix: *L*

QC Group	Run Sequence	CAS #	Analyte	Result	Units	Dilution Factor	Detection Limit	Code	Prep Date	Run Date
0407588-01A		**EPA 200.8 Metals by ICP-MS**					By:	BAS		
M041128	MT 2004 1456 12	7440-38-2	Arsenic, dissolved	ND	mg / L	1	0.0005		07-28-04	08-03-04
0407588-01A		**EPA 4.1.1/200.7 ICP**					By:	KDW		
M041146	MT 2004 1494 75	7440-70-2	Calcium, dissolved	350	mg / L	108	0.4		08-04-04	08-09-04
M041146	MT 2004 1494 75	7439-89-6	Iron, dissolved	ND	mg / L	108	0.05		08-04-04	08-09-04
M041146	MT 2004 1494 75	7439-95-4	Magnesium, dissolved	70.9	mg / L	108	0.1		08-04-04	08-09-04
M041146	MT 2004 1494 75	7439-96-5	Manganese, dissolved	ND	mg / L	108	0.01		08-04-04	08-09-04
M041146	MT 2004 1516 20	7440-09-7	Potassium, dissolved	120	mg / L	108	0 2		08-04-04	08-11-04
M041146	MT 2004 1516 20	7440-21-3	Silicon, dissolved	29.2	mg / L	108	0.1	E	08 04-04	08-11-04
M041146	MT 2004 1516 20	7440-23-5	Sodium, dissolved	2590	mg / L	108	0.2		08-04-04	08-11-04

Sample: ***INJECTION TEST WELL- GAS*** Collected: *07-26-04 19:50:00* By:
Matrix: *L*

QC Group	Run Sequence	CAS #	Analyte	Result	Units	Dilution Factor	Detection Limit	Code	Prep Date	Run Date
0407588-02A		**EPA 4.1.3/200.7 ICP**					By:	KDW		
M041144	MT 2004 1461 41	7440-38-2	Arsenic	0 37	mg / L	1	0 19		08-03-04	08-03-04
M041144	MT 2004 1496 85	7440-70-2	Calcium	349	mg / L	10	0.1		08-03-04	08-09-04
M041144	MT 2004 1461 41	7439-89-6	Iron	1 74	mg / L	1	0.07		08-03-04	08-03-04
M041144	MT 2004 1461 41	7439-95-4	Magnesium	70.7	mg / L	1	0 6		08 03 04	08 03-04
[illegible]144	MT 2004 1461 41	7439-96-5	Manganese	0.22	mg / L	1	0.02		08-03-04	08-03-04
[illegible]144	MT 2004 1517 21	7440-09-7	Potassium	ND	mg / L	100	2.5		08-03-04	08 11 04
[illegible]1144	MT 2004 1461 41	7440-21-3	Silicon	15.9	mg / L	1	0.4	E	08-03-04	08-03-04

SQLCoyote: Reports 1.1.0406250652XX *Report Date 8/23/2004 1:43:35 PM*

STANDARD

Assaigai Analytical Laboratories, Inc.

Certificate of Analysis

C' **UNITED DRILLING CO.**
Project: **JDF INJECTION**
Order: **0407588 UNI01E** Receipt: **07-27-04**

Sample. ***INJECTION TEST WELL- GAS*** Collected: *07-26-04 19:50:00* By:
Matrix ***L***

QC Group	Run Sequence	CAS #	Analyte	Result	Units	Dilution Factor	Detection Limit	Code	Prep Date	Run Date
0407588-02A		**EPA 4.1.3/200.7 ICP**					By:	KDW		
M041144	MT.2004 1517 21	7440-23-5	Sodium	2610	mg / L	100	0.2		08-03-04	08-11-04
0407588-02A		**SM 2340B**					By:	MW		
HARD	MT 2004 1500 1		Hardness, as CaCO3	1160	mg / L	1	0		08-10-04	08-10-04
0407588-02B		**EPA 120.1 Specific Conductance**					By:	JPH		
WCOND04049	WC 2004 2194 4		Conductivity	14600	umhos/cm	1	1		07-28-04	07-28-04
0407588-02B		**EPA 160.1 Total Dissolved Solids**					By:	JPH		
WTDS-04-089	WC 2004 2170.4		Total Dissolved Solids	8370	mg/L	1	10		07-28-04	07-29-04
0407588-02B		**EPA 180.1 Turbidity, Nephelometric**					By	RAP		
WTURB04074	WC 2004 2156 2		Turbidity	21 1	NTU	1	0 3		07-28-04	07 28-04
0407588-02B		**EPA 300.0 Anions by IC**					By:	DAW		
W04540	WC 2004 2174 10		Bromide	5.27	mg / L	10	0 05		07-28-04	07-28-04
W[illegible]	WC 2004.2187 18	16887-00 6	Chloride	4500	mg / L	500	0.05		07-30-04	07-30-04
V[illegible]	WC.2004 2187 19	16984-48-8	Fluoride	3.16	mg / L	10	0.05		07-30-04	07-30-04
W04540	WC.2004 2174 10	14797-65-0	Nitrate, as N	ND	mg / L	10	0.05		07-28-04	07-28-04
W04540	WC 2004 2174.10	14797-55-8	Nitrite, as N	1.22	mg / L	10	0.05		07-28-04	07-28-04
W04540	WC 2004.2174 9		Sulfate	822	mg / L	100	0.05		07-28-04	07-28-04
0407588-02B		**EPA 310.1 Alkalinity, Titrimetic**					By:	RAC		
WALK04056	WC.2004.2285 2		Alkalinity, Bicarbonate	302	mg / L	1	2		08-05-04	08-05-04
WALK04056	WC.2004.2285.2		Alkalinity, Carbonate	ND	mg / L	1	2		08-05-04	08-05-04
WALK04056	WC.2004 2285 2		Alkalinity, Total	302	mg / L	1	2		08-05-04	08-05-04
0407588-02B		**SM 2120B**					By.	KRL		
COL04049	WC 2004 2165.2		Color	50	APHA	1	5		07-28-04	07-28-04
0407588-02B		**SM 2330B**					By.	MVR		
LANGL	WC 2004.2295 1		Langlier Saturation Index	0.50	N/A	1	0		08-10-04	08-10-04
0407588-02B		**SM 2710F**					By:	JWB		
SPEG-04-007	WC 2004 2396 5		Specific Gravity	1.0062	N/A	1	1		08-23-04	08-23-04
SPEG 04-007	WC 2004.2396 5		Temperature	19	°C	1	1		08-23-04	08-23-04
0407588-02C		**EPA 900.0**					By	JF		
ARS041354	SB 2004 424 1		Gross Alpha	445.900+/- 63.429	pCi/L	1	28.001	S	08-09-04	08-09-04
ARS041354	SB 2004 424 1		Gross Beta	199 500+/- 27 769	pCi/L	1	29 376	S	08-09-04	08-09-04

Assaigai Analytical Laboratories, Inc.

Certificate of Analysis

C' **UNITED DRILLING CO.**

Project **JDF INJECTION**

Order **0407588** **UNI01E** Receipt: **07-27-04**

Unless otherwise noted, all samples were received in acceptable condition and all sampling was performed by client or client representative. Sample result of ND indicates Not Detected, ie result is less than the sample specific Detection Limit. Sample specific Detection Limit is determined by multiplying the sample Dilution Factor by the listed Reporting Detection Limit. All results relate only to the items tested. Any miscellaneous workorder information or footnotes will appear below:

MEMO: Pursuant to Standard Methods Figure 4500-CO2 for Free Carbon Dioxide, the Total Dissolved Solids and Bicarbonate Alkalinity parameters utilized for the calculation are above the nomograph scale. Therefore, one can assume that the Free Carbon Dioxide in this sample is greater than 2000 mg/L.

Radiologicals were subcontracted to American Radiation Services, Inc.

P-Alkalinity is non-detected (ND) as the pH of the sample is less than 8.3 pH units.

The pH was analyzed with the alkalinity on 8/5/04 at 8:00 am, the result is 7.32 at a temperature of 20.9 degrees C.

Appendix C Chemical Analyses for Current Non-Dilute Concentrate

ANALYTICAL REPORT

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

LABORATORY SERVICES
4100-L DELTA DRIVE
TELEPHONE (915) 594-5725 FAX (915) 594-5430

Sampling Location: Kay Bailey Hutchison Desalination Plant
Art Ruiz (915) 621-2051
10751 Montana
El Paso, Texas 79935

Requested By: Bill Hutchison (915) 954-5516
Hydrogeology FAX: (915) 594-5572
1154 Hawkins
El Paso, Texas 79925

Laboratory #: 09-16523
Sample Identification: KB-Concentrate Pump Effluent
Sampling Source: Tap at Pumps
Sample Type: Grab

Date/Time Collected: 6/9/2009 @ 5:14
Collected By: EFD
Date Received: 6/9/2009
Report Date: 6/26/2009

Analysis	Analytical Method		Result	Dilution	Reporting Limit	Units	Analysis Date	Analysis Time	Analyzed By
Uranium, total	ASTMD2907-		2.8	1	0.5	pCi/L	6/10/2009	19:33	LH at HAZ
Uranium, total	ASTMD2907-		4.1	1	0.7	ug/L	6/10/2009	19:33	LH at HAZ
Asbestos	EPA 100.1/.2	<	0.1952	1	0.1952	S/L 10E6	6/15/2009	11:00	KM at CAS
Total Hardness as CaCO3	EPA 130.1		635	2	50	mg/L	6/9/2009		LRA at INT
Odor	EPA 140.1	<	1.00	1	1	TON	6/10/2009		JV at ULI
Aluminum, soluble	EPA 200.7	<	0.020	1	0.02	mg/L	6/16/2009		RRH at MET
Barium, soluble	EPA 200.7		0.142	1	0.01	mg/L	6/16/2009		RRH at MET
Beryllium, soluble	EPA 200.7	<	0.002	1	0.002	mg/L	6/16/2009		RRH at MET
Boron, soluble	EPA 200.7		0.076	1	0.02	mg/L	6/16/2009		RRH at MET
Calcium,total	EPA 200.7		190	1	10	mg/L	6/9/2009		RRH at MET
Chromium, soluble	EPA 200.7	<	0.005	1	0.005	mg/L	6/16/2009		RRH at MET
Copper, soluble	EPA 200.7	<	0.010	1	0.01	mg/L	6/16/2009		RRH at MET
Iron, soluble	EPA 200.7		0.031	1	0.02	mg/L	6/16/2009		RRH at MET
Lithium, soluble	EPA 200.7		0.155	1	0.02	mg/L	6/16/2009		RRH at MET
Magnesium, total	EPA 200.7		49.6	5	0.5	mg/L	6/9/2009		RRH at MET
Manganese, soluble	EPA 200.7		0.044	1	0.01	mg/L	6/16/2009		RRH at MET
Nickel, soluble	EPA 200.7	<	0.010	1	0.01	mg/L	6/16/2009		RRH at MET
Phosphorous, Total	EPA 200.7	<	0.2	1	0.2	mg/L	6/9/2009		RRH at MET
Potassium total	EPA 200.7		26.4	1	2	mg/L	6/9/2009		RRH at MET
Sodium, total	EPA 200.7		825	5	10	mg/L	6/9/2009		RRH at MET
Zinc, soluble	EPA 200.7	<	0.020	1	0.02	mg/L	6/16/2009		RRH at MET
Antimony, soluable	EPA 200.8	<	0.500	1	0.5	µg/L	6/9/2009		DAR at MET
Arsenic, soluable	EPA 200.8		14.0	1	0.5	µg/L	6/9/2009		DAR at MET
Cadmium, soluable	EPA 200.8	<	0.500	1	0.5	µg/L	6/9/2009		DAR at MET
Lead, soluable	EPA 200.8	<	0.500	1	0.5	µg/L	6/9/2009		DAR at MET
Selenium, soluable	EPA 200.8	<	0.500	1	0.5	µg/L	6/9/2009		DAR at MET
Silver, soluable	EPA 200.8	<	0.500	1	0.5	µg/L	6/9/2009		DAR at MET
Thallium, soluable	EPA 200.8	<	0.500	1	0.5	µg/L	6/9/2009		DAR at MET
Mercury, soluable	EPA 245.2	<	0.0005	1	0.0005	mg/L	6/12/2009		DAR at MET
Bromide	EPA 300.1 A.		0.37	5	0.05	mg/L	6/10/2009	14:34	WWW at INT
Chloride	EPA 300.1 A.		1470	100	1	mg/L	6/12/2009	14:17	WWW at INT
Fluoride	EPA 300.1 A.		1.07	5	0.1	mg/L	6/10/2009	14:34	WWW at INT
Nitrogen-Nitrate	EPA 300.1 A.		0.57	5	0.1	mg/L	6/10/2009	14:34	WWW at INT
Nitrogen-Nitrite	EPA 300.1 A.	<	0.25	5	0.05	mg/L	6/10/2009	14:34	WWW at INT
ortho-Phosphate	EPA 300.1 A.	<	0.25	5	0.05	mg/L	6/10/2009	14:34	WWW at INT
Sulfate	EPA 300.1 A.		294	100	1	mg/L	6/12/2009	14:17	WWW at INT
Gross Alpha, Less Radon & Uranium	EPA 900.0		0.5 (± 2.4)	1	2.3	pCi/L	6/11/2009	13:00	AN at HAZ

ANALYTICAL REPORT

LABORATORY SERVICES
4100-L DELTA DRIVE
TELEPHONE (915) 594-5725 FAX (915) 594-5430

Sampling Location: Kay Bailey Hutchison Desalination Plant
Art Ruiz (915) 621-2051
10751 Montana
El Paso, Texas 79935

Requested By: Bill Hutchison (915) 954-5516
Hydrogeology FAX: (915) 594-5572
1154 Hawkins
El Paso, Texas 79925

Laboratory #: 09-16523
Sample Identification: KB-Concentrate Pump Effluent
Sampling Source: Tap at Pumps
Sample Type: Grab

Date/Time Collected: 6/9/2009 @ 5:14
Collected By: EFD
Date Received: 6/9/2009
Report Date: 6/26/2009

Analysis	Analytical Method		Result		Dilution	Reporting Limit	Units	Analysis Date	Analysis Time	Analyzed By
Gross Alpha, total	EPA 900.0		3.3 (± 2.4)		1	2.3	pCi/L	6/11/2009	13:00	AN at HAZ
Gross Beta, total	EPA 900.0		2.9 (± 2.0)		1	2	pCi/L	6/11/2009	13:00	AN at HAZ
Radium-228, total	EPA Ra-05		1.1 (± 0.8)		1	0.7	pCi/L	6/11/2009	12:55	SB at HAZ
Color	SM 2120 E	<	25	DH	1	25	ADMI	6/9/2009	13:55	YLR at DMD
Color, pH adjusted to 7.6	SM 2120 E	<	25		1	25	ADMI	6/9/2009	13:55	YLR at DMD
Turbidity	SM 2130 B		0.08		1	0.02	NTU	6/9/2009	12:05	GQG at WET
Alkalinity, Total	SM 2320 B		142	MH	1	5	mg/L	6/9/2009		DDH at WET
Electrical Conductivity	SM 2510 B		5210		1	10	µmho/cm	6/9/2009		LQM at WET
Total Dissolved Solids	SM 2540 C		3160		1	1	mg/L	6/9/2009		JCC at DMD
Temperature	SM 2550 B		26.5		1	0.1	°C	6/9/2009	5:14	EFD at Field
Total Organic Carbon	SM 5310 B.	<	1.0		1	1	mg/L	6/11/2009		AJM at INT
Radium-226, total	SM 7500-Ra B		1.2 (± 0.3)		1	0.1	pCi/L	6/11/2009	10:25	AN at HAZ
Langlier Index	SM2330 B		0.69		1			6/16/2009		RMA at WET
Cyanide, Total	SM4500 CN E	<	0.02		1	0.02	mg/L	6/17/2009		ASK at CAS
pH	SM4500 H+ B		7.8		1	2	pH units	6/9/2009	5:14	EFD at Field
Hydrogen Sulfide	SM4500-S2-	<	0.1		1	0.1	mg/L	6/9/2009	5:14	EFD at Field
Silica	SM4500-Si F		59.5		5	5	mg/L	6/16/2009		JVC at INT
Surfactants	SM5540 A	<	0.02		1	0.02	mg/L	6/9/2009		YLA at WET

MH-The Matrix Spike and/or Matrix Spike Duplicate (MS/MSD) recovery for this analyte were above the laboratory quality control limit. The reported sample concentration is estimated.

Subcontractors

CAS	Continental Analytical Services	525 N. Eighth St.	Salina, Kansas 67402-3737	KDHE: E-10146
CSP	Crisp Analytical	2081 Hutton Drive, Suite 301	Carrollton, Texas 75006	
HAZ	Hazen Research, Inc	4601 Indiana St	Golden, Colorado 80403	
ULI	Underwriters Laboratories Inc.	110 South Hill Street	South Bend, Indiana 46617-27	KS: E-10233

Paul R. Rivas
Laboratory Services Manager

6/26/2009
Date

Analyses performed utilizing procedures published in Standard Methods for the Examination of Water and Wastewater, 21st Edition 2005 or EPA Methods for the Chemical Analysis of Water and Wastes [EPA-600/4-79-020], March 1983 and the latest promulgated updates.

ANALYTICAL REPORT

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

LABORATORY SERVICES
4100-L DELTA DRIVE
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Sampling Location: Kay Bailey Hutchison Desalination Plant
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10751 Montana
El Paso, Texas 79935

Requested By: Bill Hutchison (915) 954-5516
Hydrogeology FAX: (915) 594-5572
1154 Hawkins
El Paso, Texas 79925

Laboratory #: 09-16525
Sample Identification: KB-Concentrate Effluent
Sampling Source: Concentrate Effluent
Sample Type: Grab

Date/Time Collected: 6/9/2009 @ 5:28
Collected By: EFD
Date Received: 6/9/2009
Report Date: 6/26/2009

Analysis	Analytical Method		Result	Dilution	Reporting Limit	Units	Analysis Date	Analysis Time	Analyzed By
Uranium, total	ASTMD2907-		7.7	1	0.5	pCi/L	6/10/2009	19:33	LH at HAZ
Uranium, total	ASTMD2907-		11	1	0.7	ug/L	6/10/2009	19:33	LH at HAZ
Asbestos	EPA 100.1/.2	<	0.1952	1	0.1952	S/L 10E6	6/15/2009	11:00	KM at CAS
Total Hardness as CaCO3	EPA 130.1		2160	10	50	mg/L	6/9/2009		LRA at INT
Odor	EPA 140.1	<	1.00	1	1	TON	6/10/2009		JV at ULI
Aluminum, soluble	EPA 200.7	<	0.020	1	0.02	mg/L	6/16/2009		RRH at MET
Barium, soluble	EPA 200.7		0.233	1	0.01	mg/L	6/16/2009		RRH at MET
Beryllium, soluble	EPA 200.7	<	0.002	1	0.002	mg/L	6/16/2009		RRH at MET
Boron, soluble	EPA 200.7		0.093	1	0.02	mg/L	6/16/2009		RRH at MET
Calcium,total	EPA 200.7		520	10	10	mg/L	6/9/2009		RRH at MET
Chromium, soluble	EPA 200.7	<	0.005	1	0.005	mg/L	6/16/2009		RRH at MET
Copper, soluble	EPA 200.7	<	0.010	1	0.01	mg/L	6/16/2009		RRH at MET
Iron, soluble	EPA 200.7		0.098	1	0.02	mg/L	6/16/2009		RRH at MET
Lithium, soluble	EPA 200.7		0.410	1	0.02	mg/L	6/16/2009		RRH at MET
Magnesium, total	EPA 200.7		139	10	0.5	mg/L	6/9/2009		RRH at MET
Manganese, soluble	EPA 200.7		0.138	1	0.01	mg/L	6/16/2009		RRH at MET
Nickel, soluble	EPA 200.7	<	0.010	1	0.01	mg/L	6/16/2009		RRH at MET
Phosphorous, Total	EPA 200.7		0.7	1	0.2	mg/L	6/9/2009		RRH at MET
Potassium total	EPA 200.7		60.7	10	2	mg/L	6/9/2009		RRH at MET
Sodium, total	EPA 200.7		2570	10	10	mg/L	6/9/2009		RRH at MET
Zinc, soluble	EPA 200.7	<	0.020	1	0.02	mg/L	6/16/2009		RRH at MET
Antimony, soluable	EPA 200.8	<	0.500	1	0.5	µg/L	6/9/2009		DAR at MET
Arsenic, soluable	EPA 200.8		39.4	1	0.5	µg/L	6/9/2009		DAR at MET
Cadmium, soluable	EPA 200.8	<	0.500	1	0.5	µg/L	6/9/2009		DAR at MET
Lead, soluable	EPA 200.8		0.500	1	0.5	µg/L	6/9/2009		DAR at MET
Selenium, soluable	EPA 200.8	<	0.500	1	0.5	µg/L	6/9/2009		DAR at MET
Silver, soluable	EPA 200.8	<	0.500	1	0.5	µg/L	6/9/2009		DAR at MET
Thallium, soluable	EPA 200.8	<	0.500	1	0.5	µg/L	6/9/2009		DAR at MET
Mercury, soluable	EPA 245.2	<	0.0005	1	0.0005	mg/L	6/12/2009		DAR at MET
Bromide	EPA 300.1 A.	<	0.25	5	0.05	mg/L	6/10/2009	15:12	WWW at INT
Chloride	EPA 300.1 A.		4260	100	1	mg/L	6/15/2009	14:30	WWW at INT
Fluoride	EPA 300.1 A.		2.81	5	0.1	mg/L	6/10/2009	15:12	WWW at INT
Nitrogen-Nitrate	EPA 300.1 A.	<	0.50	5	0.1	mg/L	6/10/2009	15:12	WWW at INT
Nitrogen-Nitrite	EPA 300.1 A.	<	0.25	5	0.05	mg/L	6/10/2009	15:12	WWW at INT
ortho-Phosphate	EPA 300.1 A.	<	0.25	5	0.05	mg/L	6/10/2009	15:12	WWW at INT
Sulfate	EPA 300.1 A.		902	100	1	mg/L	6/15/2009	14:30	WWW at INT
Gross Alpha, Less Radon & Uranium	EPA 900.0		12 (± 7)	1	6.4	pCi/L	6/11/2009	13:00	AN at HAZ

ANALYTICAL REPORT

LABORATORY SERVICES
4100-L DELTA DRIVE
TELEPHONE (915) 594-5725 FAX (915) 594-5430

Sampling Location: Kay Bailey Hutchison Desalination Plant
Art Ruiz (915) 621-2051
10751 Montana
El Paso, Texas 79935

Requested By: Bill Hutchison (915) 954-5516
Hydrogeology FAX: (915) 594-5572
1154 Hawkins
El Paso, Texas 79925

Laboratory #: 09-16525
Sample Identification: KB-Concentrate Effluent
Sampling Source: Concentrate Effluent
Sample Type: Grab

Date/Time Collected: 6/9/2009 @ 5:28
Collected By: EFD
Date Received: 6/9/2009
Report Date: 6/26/2009

Analysis	Analytical Method		Result		Dilution	Reporting Limit	Units	Analysis Date	Analysis Time	Analyzed By
Gross Alpha, total	EPA 900.0		20 (± 7)		1	6.4	pCi/L	6/11/2009	13:00	AN at HAZ
Gross Beta, total	EPA 900.0		0.4 (± 6.2)		1	6.2	pCi/L	6/11/2009	13:00	AN at HAZ
Radium-228, total	EPA Ra-05		2.1 (± 0.8)		1	0.7	pCi/L	6/11/2009	12:55	SB at HAZ
Color	SM 2120 E	<	25	DH	1	25	ADMI	6/9/2009	13:55	YLR at DMD
Color, pH adjusted to 7.6	SM 2120 E	<	25		1	25	ADMI	6/9/2009	13:55	YLR at DMD
Turbidity	SM 2130 B		0.05		1	0.02	NTU	6/9/2009	12:05	GQG at WET
Alkalinity, Total	SM 2320 B		312	MH	1	5	mg/L	6/9/2009		DDH at WET
Electrical Conductivity	SM 2510 B		15400		2	10	µmho/cm	6/9/2009		LQM at WET
Total Dissolved Solids	SM 2540 C		9470		1	1	mg/L	6/9/2009		JCC at DMD
Temperature	SM 2550 B		26.5		1	0.1	°C	6/9/2009	5:28	EFD at Field
Total Organic Carbon	SM 5310 B.	<	1.0		1	1	mg/L	6/11/2009		AJM at INT
Radium-226, total	SM 7500-Ra B		3.3 (± 0.5)		1	0.1	pCi/L	6/11/2009	10:25	AN at HAZ
Langlier Index	SM2330 B		1.41		1			6/16/2009		RMA at WET
Cyanide, Total	SM4500 CN E	<	0.02		1	0.02	mg/L	6/17/2009		ASK at CAS
pH	SM4500 H+ B		7.8		1	2	pH units	6/9/2009	5:28	EFD at Field
Hydrogen Sulfide	SM4500-S2-	<	0.1		1	0.1	mg/L	6/9/2009	5:28	EFD at Field
Silica	SM4500-Si F		110		5	5	mg/L	6/16/2009		JVC at INT
Surfactants	SM5540 A	<	0.02		1	0.02	mg/L	6/9/2009		YLA at WET

MH-The Matrix Spike and/or Matrix Spike Duplicate (MS/MSD) recovery for this analyte were above the laboratory quality control limit. The reported sample concentration is estimated.

Subcontractors

CAS	Continental Analytical Services	525 N. Eighth St.	Salina, Kansas 67402-3737	KDHE: E-10146
CSP	Crisp Analytical	2081 Hutton Drive, Suite 301	Carrollton, Texas 75006	
HAZ	Hazen Research, Inc	4601 Indiana St	Golden, Colorado 80403	
ULI	Underwriters Laboratories Inc.	110 South Hill Street	South Bend, Indiana 46617-27	KS: E-10233

Paul R. Rivas
Laboratory Services Manager

6/26/2009
Date

Analyses performed utilizing procedures published in Standard Methods for the Examination of Water and Wastewater, 21st Edition 2005 or EPA Methods for the Chemical Analysis of Water and Wastes [EPA-600/4-79-020], March 1983 and the latest promulgated updates.

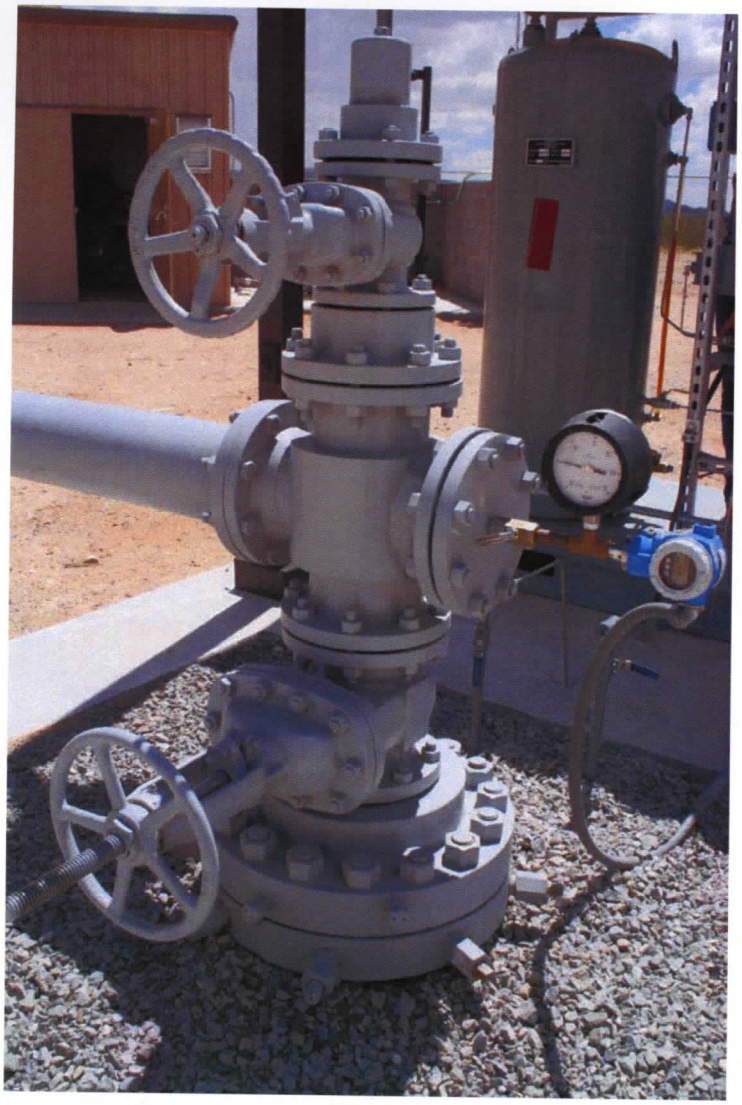
Appendix D Site Photographs

Kay Bailey Hutchison Desalination Plant

Surface Injection Facility No. 1. (Well JDF-1).
View looking south-southeast.

View from JDF-1 looking west towards the City of El Paso.

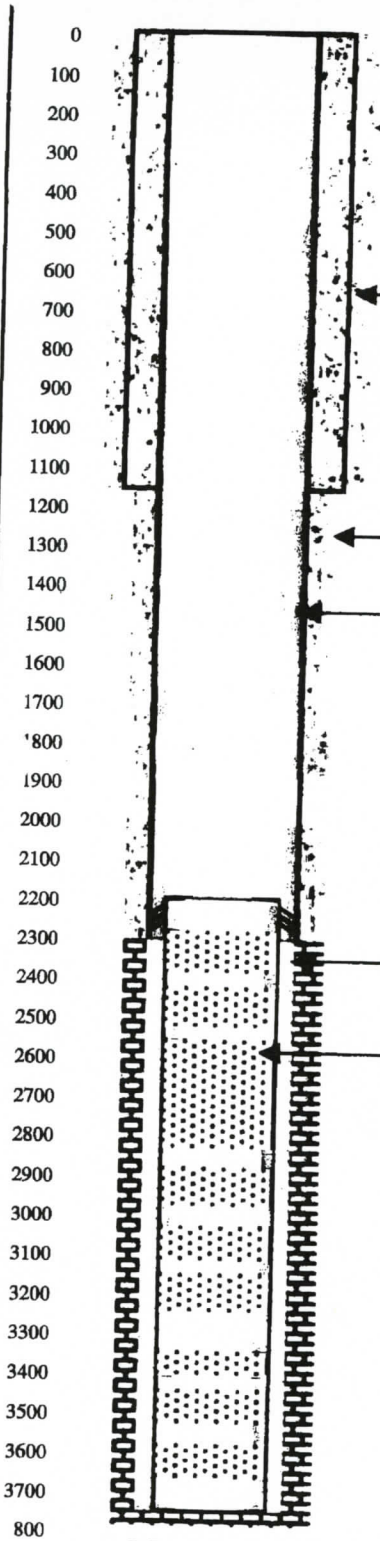
Surface Injection Facility No. 2. (Well JDF-2).
View looking west.



Surface Injection Facility No. 3 (Well JDF-3).
View looking south-southeast.

Appendix E Available Well Records

EPWU Pilot Well No. 1



Ground Level Elevation 4152' Kelly Bushing Elevation 4164'

ALL DEPTHS MEASURED FROM KELLY BUSHING

Surface Hole: 12-1/4" pilot hole opened to 17-1/2" to depth of 1118 feet.

Surface Casing: 13-3/8" 54.5 ppf; J-55; ST&C (0.380" wall). Ran a total of 25 joints (1116.40 ft) with Gemco Float Shoe at 1113 ft, Gemco Float Collar at 1067 ft and Gemco Stage Collar at 622 feet. Cemented by BJ with 400 sacks (536 cu ft) Class C + 1% CaCl2 + 0.25 lb/sk Cello Flake. Displaced 98 bbl of slurry with 165 bbl of water. Plug down with good circulation throughout. Opened stage tool and circulated out 10 bbl (42 sacks) of cement. Circulated 7 hours between stages and cemented second stage with 671 sacks of Class C + 2% CaCl2 at 14.8 ppg. Recovered 37 bbls cement returns at 13.2 ppg. Witness by Jim Neeley (TCEQ)

Intermediate Hole: 12-1/4" drilled to 2315'.

Injection Casing: 9-5/8" 36 ppf; J-55; ST&C (.352" wall). Ran 52 joints with Gemco float shoe set at 2315 feet, float collar set at 2267 feet, and stage collar set at 1108 feet. Circulated the last 70 feet to bottom. BJ cemented first stage with 400 sacks Class "C" mixed at 14.8 ppg with 1.33 cubic feet/sk yield for total volume of 532 cubic feet or 37% excess over caliper volume. Displaced with water. Had partial returns throughout cement job. Opened stage tool and circulated out contaminated water (max wt 8.7 ppg). Circulated for second stage 8 hours. Cemented second stage with 140 sx Class C (185 cu ft as above) followed by 450 sx Class C with 1% CaCl2, mixed at 14.8 ppg, yield 1.32 cu ft/sk, 594 cu ft. Closed stage tool. Had 100% returns throughout. Circulated out 196 sx excess cement. Calculated annular volume 400 cu ft, cement volume 780 cu ft, for 95% excess. Overall cement volume 1312 cu ft, annular volume 786 cu ft for 69% excess. Witnessed by Jim Neeley (TCEQ).

Injection Interval Hole: 8-3/4" drilled to 3770'.

Injection Liner: 6-5/8" 24 ppf; K-55; Ventura Flush Joint Thread (.352" wall); drilled and blank liner with a perforated dovetail shoe and Weatherford CMS mechanical liner hanger. Liner bottom at 3774', Liner Hanger at 2189' and the top of Polished Bore Receptacle at 2180'.

18 joints of the liner are perforated with 60 (3/8") drilled holes per foot. The perforated joints were spaced out in the liner at the following depth intervals: 2290-2380; 2427-2517; 2561-2841; 2888-2981; 3028-3122; 3169-3263; 3354-3402; 3449-3538; 3585-3678.

I, James D. Bundy, P.E., do certify that the proposed engineering design contained on this page is technically sound.

_____, P.E. Date: _____

Registered Professional Engineer No. 73267

SUBSURFACE HOUSTON, TX SOUTH BEND, IN BATON ROUGE, LA

FIGURE VI.B.1-1

El Paso Water Utilities

I.W. No. 1

DATED: 7/15/03	APPROVED BY:	JOB NO. 60D5614
DRAWN BY: JDB	CHECKED BY:	SCALE: N/A

JOHN SHOMAKER AND ASSOCIATES, INC.
JDF INJECTION TEST WELL NO. 1
UNITED DRILLING, INC. RIG 5
LITHOLOGY LOG

NOTES	DEPTH, FT.	INTERVAL FEET	PENETRATION RATE / MIN.	DESCRIPTION
NOTES: Drilling below conductor casing w/ 12 1/4" pilot hole all depths are Kelly Bushing (after 100ft.)	0 -10			Clay, light brown, high plasticity, minor sand, coarse
	10 - 40			Clay, lt. brown, high plasticity; calcite, white to lt. tan, fair to mod. consolidation, minor sand & gravel, primarily limestone
	40 - 60			Silty clay, low-mod plasticity, minor carbonate, small - 1/16" diameter clay fragments, probably from thin clay loose with moderate consolidation
	60 -100			As above with minor amounts caliche, poorly consolidated
	100 - 140			Clay, lt. brown, high plasticity, minor sand, med., subangular to angular <5%, primarily limestone
	140 - 170	140-150 150-160 160-171	3.5 3.5 5.0	Silty caly, lt. brown, mod. plasticity, clay lense, brown, low consolidation, minor-mod sand, mod. grained; minor sand, subangular-angular, limestone
	170 - 260	170-180 180-190 190-200	4.0 4.8 3.7	Clay, lt. brown, high plasticity
		200-210 210-220 220-230	3.8 4.1 CLOCK ON GEO NOT WORKING	
		230-240 240-250 250-260	CLOCK ON GEO. NOT WORKING	
	260 - 280	260-270 270-280	2.3 2.4	Clay, lt. browm, mod.-high plasticity, sand, <10%, fine grained, subangular, quartz, limestone
NOTES: 12 1/4" Pilot Holes, All depths KB, KB is 12 FT Above Ground Level	280 - 290			Clay, lt. brown, high plasticity, thin beds of clay, reddish-brown interbedded, minor <5% sand, fine-coarse, subrded-subangular, quartz, limestone, various lithics
	290 - 310	290-300 300-310	2.4 3.6	Clay, lt. brown, high plasticity
	310 - 320	310-320	2.0	Sand, fine-coarse, subrded-angular,limestone, volcanics, quartz, poorly sorted

JOHN SHOMAKER AND ASSOCIATES, INC.
JDF INJECTION TEST WELL NO. 1
UNITED DRILLING, INC. RIG 5
LITHOLOGY LOG

NOTES	DEPTH, FT.	INTERVAL FEET	PENETRATION RATE / MIN.	DESCRIPTION
	320 - 340	320-330 330-340	3.0 3.2	Clay, lt. brown, high plasticity, minor sand, <5%, subrded-subangular, limestone, volcanics, quartz
	340 - 469	340-350 350-360 360-370	3.2 3.0 3.0	Clay, lt. brown, high plasticity
		370-380 380-390 390-400	2.4 3.2 3.0	
		400-410 410-420 420-430	2.0 2.2 2.0	
		430-440 440-450 450-460	1.8 1.8 2.2	
		460-470	1.5	
	469 - 480	470-480	1.6	Clay, lt. brown, high plasticity, sand, fine-coarse, subrnded-angular, limestone, some volcanics, 60% clay, 40% sand, core from nearby test hole reported as siltstone and conglomerate
	480 - 490	480-490	1.5	As above w/ ~ 25% conglomerate, 75% clay
	490 - 500	490-500	1.4	Limestone, grey, mod. dark grey, siltstone, tan to yellow, well consolidated, clay/silt 10-15% mixed in
	500 - 520	500-510 510-520	1.2 2.0	Conglomerate, limestone, lt. grey to dark grey, not igneous offer, siltstone yellow (<5%), clay, lt. brown, high plasticity ~ 20-25% clay
	520 - 530	520-530	1.8	As above w/ decreased clay content, clay ~ 10-15%
	530 - 550	530-540 540-550	1.4 1.4	Conglomerate, primarily limestone, grey to dark grey, black, siltstone, brownish-yellow, clay, lt. brown, ~ 20% of samples
	505 - 570	550-560 560-570	2.0 1.0	Conglomerate as above w/ ~10-15% clay
NOTES: 12 1/4" Pilot Hole, KB is 12' above Ground Level, *Use of term "conglomerate" is based on reported lithology from cores @ TH03	570 - 590	570-580 580-590	2.0 1.4	Conglomerate, 90% limestone, lit. grey to black, angular-consolidated faces; remaining 10% brownish yellow silstone, well consolidated; poorly consolidated shale, brwn; a few qtz grains

JOHN SHOMAKER AND ASSOCIATES, INC.
JDF INJECTION TEST WELL NO. 1
UNITED DRILLING, INC. RIG 5
LITHOLOGY LOG

NOTES	DEPTH, FT.	INTERVAL FEET	PENETRATION RATE / MIN.	DESCRIPTION
	590 - 630	590-600		
		600-610	2.0	Conglomerate, >95% limestone, mostly grey, but also lt-dk grey; minor amts of reddish brwn shale, poorly consolidated;
		610-620	2.2	
		620-630	2.2	siltstone, brwnish yellow; and qtz grains
	630 - 660	630-640	4.6	limestone 90%, mostly grey w/ same dark and lt. grey;
		640-650	7.2	reddish brwn clay <5%, minor amts of brwnish yellow
		650-660	5.6	sitstone and reddish chert
	660 - 670	660-670	5.6	limestone >95%, mostly grey w/ some dk and lt grey; minor evaporites and redish and brwnish yellow silstone
	670 - 680	670-680	2.6	~90% limestone, mostly grey w/ some lit and dk grey; yellowish brwn clay and siltstone
	680 - 690	680-690	2.8	~50% limestone, grey and dk grey; ~50% dk grey clay/shale
	690 - 720	690-700		
		700-710	2.4	
		710-720	5.5	limestone ~95%, mostly dk grey; minor reddish clay
	720 - 730	720-730	5.8	>95%limestone, mostly dk grey and black; minor reddish clay and reddish silstone
	730 - 740	730-740	7.0	>95% limestone, mostly dk grey and black; minor calcited,
		740-750	3.6	reddish clay, evaporites
	740-790	740-750	3.6	
NOTES: 12 1/4" Pilot Hole		750-760	2.4	
		760-770	3.2	shale, black, poor to mod. Consolidation, carbonaceous
	790-830	770-780	2.4	
		780-790	3.0	shale, black, mod to well consolid., carbonaceous; <5%
		790-800	5.2	limestone, grey and shale, reddish brwn, poor consolid.
		800-810	4.2	
		810-820	4.4	
		820-830	3.6	
	830-840	830-840	2.4	
		840-850	4.4	shale black, poor-mod consolid., carbonaceous
	840-860	850-860	6.2	shale, black, mod - well consolid, carbonaceous; shale (1-2%), reddish brwn, poor - mod consolid.
	860-940	860-870	6.4	shale, black, mod - well consolid, carbonaceous; limestone,
		870-880	6.2	grey <5%; shale, reddish brwn, poor consolid., lost circ.
		880-890	4.8	Material

JOHN SHOMAKER AND ASSOCIATES, INC.
JDF INJECTION TEST WELL NO. 1
UNITED DRILLING, INC. RIG 5
LITHOLOGY LOG

NOTES	DEPTH, FT.	INTERVAL FEET	PENETRATION RATE / MIN.	DESCRIPTION
		890-900	5.2	
		900-910	6.0	
		910-920	5.6	
		920-930	3.8	
		930-940	4.0	fine sand. Present 920 - 930
	940-970	940-950	4.4	shale black, med to well consolid., carbonaceous ~90%;
		950-960	7.2	shale lt grey, med consolidation <10%, minor reddish brwn
		960-970	4.8	clay
	970-1000	970-980	5.8	
		980-990	8.4	shale, back, med to well consolidated, carbonaceous,
		990-1000	5.8	extremely large amt of drlg paper make analysis difficult
	1000-1040	1000-1010	5.0	
		1010-1020	5.4	
		1020-1030	5.2	limestone, lt grey to grey, well consolidated; shale, blck, med
NOTES: 12 1/4" Pilot Hole		1030-1040	3.8	to well consolidated; ~65% limestone, 35% shale
	1040-1070	1040-1050	6.0	limestone, lt grey to grey, well consolidated; shale, blck, well
		1050-1060	5.0	consolidated; silstone, reddish brwn, poorly consolidated,
		1060-1070	5.6	~65% limestone, 35% shale; <1% siltstone
	1070-1110	1070-1080	6.0	
		1080-1090	5.6	shale, blk, well consolidated; limestone, lt grey to grey; ~90 %
		1090-1100	5.8	shale, 10% limstone; <1% siltstone, reddish brwn; poorly
		1100-1110	4.6	consolidated
	1110-1160	1110-1120	5.6	
		1120-1130	7.6	
		1130-1140	7.6	limestone, lt grey to grey, well consolidated; shale blk, well
		1140-1150	6.4	consolidated; ~90% limestone, 10% shale
		1150-1160	6.6	addition of 3% silstone
	1160-1190	1160-1170	6.3	
		1170-1180	5.0	limestone, lt grey to grey, well consolidated, crystaline; shale,
		1180-1190	7.4	blk, well consolidated, carbonaceous siltstone,
				reddish brwn; ~80% limestone, 15% shale, 5% siltstone
	1190-1200	1190-1200		limestone, dark grey to light grey; crystalline; siltstone, brwn;
				shale, black, calcareous cement; 92% limestone, 5%
				siltstone, 3% shale

JOHN SHOMAKER AND ASSOCIATES, INC.
JDF INJECTION TEST WELL NO. 1
UNITED DRILLING, INC. RIG 5
LITHOLOGY LOG

NOTES	DEPTH, FT.	INTERVAL FEET	PENETRATION RATE / MIN.	DESCRIPTION
	1200-1210			dominantly lt gray limestone, w/ some med to dark gray l.s. >95% limestone, minor dk gray to blk moderately consolidated shale, poorly consolidated tan to lt reddish brwn shale
	1210-1220	1210-1220	3.4	med to dk gray l.s. 90%-95%, 5%-10% dk gray to blk shale, mod to well consolidated
	1220-1240	1220-1230	3.4	
		1230-1240	2.8	fine brwn sandstone w/ ~5% blk shale
	1240-1290	1240-1250	3.0	
		1250-1260	3.2	med to dk gray limestone. Some calcite veins and calcite on
		1260-1270	3.6	broken surfaces. Angular fragments up to 12mm
	1290 -	1270-1280	3.4	
		1280-1290	2.6	1290 - 1300 lt gray mafic intrusive, phenocrysts, altered to
		1290-1300	3.6	calcite,
	1330	1300-1310	1.6	
		1310-1320	2.0	
		1320-1330	1.9	subang to subrounded clasts up to 15mm
	1330 - 1350	1330-1340	2.3	lt to dk gray limestone. Some white calcite on broken
		1340-1350	2.8	surfaces. Angular to subangular fragments up to 12mm
	1350-1370	1350-1360	2.2	med to kd gray limestone. Some calcite grains and calcite on
		1360-1370	2.2	broken surfaces. Med to coarsesand texture w/ a few
				~10mm ded gray limestone fragments
	1370-1380	1370-1380	2.2	lt to dk gray dolomitic limestone - less effervescent than limestone w/ calcite described above. Med sand texture
	1380-1440	1380-1390	2.4	
		1390-1400	3.0	
		1400-1410	2.8	lt to dk gray limestone. Some white calcite on broken
		1410-1420	2.8	surfaces. Angular to subangular platey fragments up to
		1420-1430	2.9	12mm
		1430-1440	3.1	Primarily medium sand texture.
	1440-1500	1440-1450	3.0	
		1450-1460	2.8	med to dk gray limestone. Some white calcite grains on
		1460-1470	2.6	broken surfaces. Angular and subangular platey fragments
		1470-1480	2.8	up to 2mm
		1480-1490	3.0	Primarily medium sand texture.
		1490-1500	2.4	Note 1480-1490 grains slightly more platey, lt to dk gray

JOHN SHOMAKER AND ASSOCIATES, INC.
JDF INJECTION TEST WELL NO. 1
UNITED DRILLING, INC. RIG 5
LITHOLOGY LOG

NOTES	DEPTH, FT.	INTERVAL FEET	PENETRATION RATE / MIN.	DESCRIPTION
	1500-1550	1500-1510	2.2	
		1510-1520	2.4	
		1520-1530	2.4	med to kdk gray limestone - mostly med sand size
		1530-1540	2.0	fragments, which are angular to subangular. Some ~5mm
*Rate for 1548-1550 after resuming drilling with mud on 6/18/04. No sample was taken for 1540-1550		1540-1550	7.5*	platey fragments of same composition.
	1550-1560	1550-1560	2.6	dk gray to very dk gray limestone with few grains of med gray limestone and white calcite; effervescense vigorously in 10% HCl; subangular grains, med sand texture
	1560-1680	1560-1570		
		1570-1580	2.9	
		1580-1590	2.6	
		1590-1600	3.0	dk gray to very dk gray limestone w/ few grains of med gray
		1600-1610	2.6	limestone, white calcite, and med brwn limestone;
		1610-1620	3.1	effervescesence vigorously in 10%HCl; angular, platey
		1620-1630	3.0	grains, coarse sand texture
		1630-1640	2.8	dk gray limestone w/ very few med gray grains limestone.
		1640-1650	2.4	mostly med to coarse sand sized texture w/ some platey
		1650-1660	2.4	fragments
		1660-1670	2.8	effervescense vigorously w/ 10%HCl
		1670-1680		rate averaged b/c geolograph stopped twice from 1600-1630.
	1680-1720	1680-1690	6.0	dk gray limestone w/ ~3% lt gray shale? Med to coarse sand
		1690-1700	2.4	sized particles, efferv vigorously w/ 10%HCl
		1700-1710	5.2	1690-1710 some increase in white to lt gray paritcles, maybe
		1710-1720	4.8	to 3%
	1720-1760	1720-1730	4.2	
		1730-1740	4.0	med gray to brwnish ded gray limestone w/ 3-5% lt gray
		1740-1750	3.6	limestone, med sand sized particles w/ some flakey. Efferv.
		1750-1760	4.1	Vigorously w/10% hcl
	1760-1780	1760-1770	7.5	50% med gray to dk gray limestone and dk gray to black shale
		1770-1780	7.4	25% lt gray limestone; 25% white calcite; angular, platey grains; efferv. Vigorously in 10% hcl; med sand texture

JOHN SHOMAKER AND ASSOCIATES, INC.
JDF INJECTION TEST WELL NO. 1
UNITED DRILLING, INC. RIG 5
LITHOLOGY LOG

NOTES	DEPTH, FT.	INTERVAL FEET	PENETRATION RATE / MIN.	DESCRIPTION
	1780-1790	1780-1790	9.4	50% med to dk gray limestone and dk gray to black shale; 25% lt gray limestone; 25% white calcite ; angular platey grains; moderately efferv. In 10% hcl; med to coarse sand texture
	1790-1800	1790-1800	8.7	75% dk gray limestone and dk gray to black shale; 12% lt gray limestone; 12% white calcite; mod efferv. In 10% hcl; angular platey grains; med sand texture
	1800-1810	1800-1810	13	med gray to brwnish med gray limestone w/ 5% lt gray limestone and white calcite; med efferv. w/10% hcl; angular, platey grains; med sand texture

JOHN SHOMAKER AND ASSOCIATES, INC.
JDF INJECTION TEST WELL NO. 1
UNITED DRILLING, INC. RIG 5
LITHOLOGY LOG

NOTES	DEPTH, FT.	INTERVAL FEET	PENETRATION RATE / MIN.	DESCRIPTION
	1810-1860	1810-1820 1820-1830 1830-1840 1840-1850 1850-1860	9.4 9.6 5.0 9.2 8.2	75% dk gray limestone and dk gray to black shale; 12% lt gray limestone; 12% white calcite; mod efferv. In 10% hcl; angular platey grains; med sand texture
	1860-1870	1860-1870	9.2	dk gray limestone to brownish dk gray limestone ~95%, white to lt gray shale ~5%, vigorous afferv w/10%hcl, minor black shale
	1870-18880	1870-1880	7.4	85% very dk gray limestone, fine to med. Sand texture ~12% lt gray limestone, ~5% dk gray to black shale. Efferv. Vigorously w/ 10% hcl
	1880-1890	1880-1890	11.2	very dk gray to black shaley limsetone w/ angular fragments up to 4mm. Minor lt gray limestone efferv vigorously w/ 10% hcl
	1890-1900	1890-1900	6.6	med gray limestone w/ coarse angular fragments, platey ~75% lt gray shale, coarse angular flakey fragments ~23%. Minor calcite efferv vigorous w/ 10% hcl
	1900-1910	1900-1910	6.3	75% med gray limestone; 12% dk gray l.s.; 6% lt gray l.s.; 6% white calcite; mod efferv in 10% hcl; ang, platey grains; med to coarse sand texture
	1910-1930	1910-1920 1920-1930	4.3 2.8	45% med gray l.s.; 45% dk gray l.s. and dark gray to black shale; 5% lt gray l.s.; 5% white calcite; mod efferv in 10% hcl; ang., platey grains; med sand texture
	1930-1940	1930-1940	3	95% dk gray l.s. and dk gray l.s. and dk gray to blk shale; 5% lt gray l.s.; trace of white calcite; mod efferv in 10% hcl; ang., platey grains; med sand texture
	1940-1960	1940-1950 1950-1960	4.0 5.8	95% dk gray l.s. and dk gray to blk shale; 5% lt gray l.s.; mod efferv in 10% hcl; ang., platey grains; med sand texture
	1960-1980	1960-1970 1970-1980	5.6 6.4	95% dk gray l.s. and dk gray to blk shale; 5% lt gray l.s.; mod efferv in 10% hcl; ang., platey grains; med to coarse sand texture
	1980-2000	1980-1990 1990-2000	5.8 5.0	95% very dk gray l.s. and very dk gray to blk shale; 5% lt gray l.s.; low to mod efferv in 10% hcl; ang., very platey grains; med to coarse sand texture

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	2000-2020	2000-2010 2010-2020	3.6 --	98% very dk gray to blk calcereous shale; 2% lt gray l.s.; low to mod efferv in 10% hcl; angular very platey grains; med to coarse sand texture
	2020-2030	2020-2030	6-Jan	~47% very dk gray to blk calcereous shale, ang flakes up to 5mm. ~45% med gray l.s. and mod consolidated shale. Minor white calcite. Mod to vigorous reaction w/10% hcl
	2030-2050	2030-2040 2040-2050	4.0 4.2	90% very dk gray to blk calcereous shale; lt gray l.s. and mod consolidated shale, mod to vigor ration w/ 10% hcl
	2050-2070	2050-2060 2060-2070	4.4 4.0	>97% very dk gray to blk shale, angular fragments up to 3mm, slightly to mod reactive w/10% hcl; minor lt gray shale and med gray l.s.
Took core from 2073' to 2103' kb; analyzed ends of 5-foot sections of sleeve	0' (bottom)			med to dk gray dolomite; finely near horiz laminated; several trace fossils; none to low efferv in 10% hcl; breaks along bumpy surfaces parallel to laminations; very fine ghrained; vitreous; clacite crystals growing across laminations; relatiively unfractured
	5'			med to dk gray dolomite; massive; low efferv in 10% hcl; conchoidal fracture; very fine grained; vitreous; relatively unfractured
	10'			dk gray to blk shale; very well consolidated; low efferv in hcl; low fissiblity; smooth, uneven breaking at low angle to horizontal; trace pyrite; relatively unfractured
	15'			dk gray to blk shale; very well consolidated; no efferv in hcl; low fissility; smooth, uneven breaking at low angle to horiz; trace pyrite; relatively unfractured
Shale is probably Devonian age Percha Shale (40' thick in Franklin Mountains.	20'			blk shale; very well consolid; no efferv in hcl; low fissility; smooth uneven breaking at low angle to horiz; trace pyrite; relatively unfractured.
	25'			blk shale; well consolid; no efferv in hcl; slightly fissile; smooth uneven breaking at low angle to horiz; trace pyrite; relatively unfractured.
Top end of the core	30' (top)			blk shale; well consolid; no efferv in hcl; slightly fissile; smooth uneven breaking at low angle to horiz; trace pyrite; relatively unfractured.
Back to Drilling	2104-2120	2104-2110 2110-2120	2.8 5.7	blk shale; well consolid; no efferv in hcl; slightly fissile; smooth, breaks irregularly.

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	2120-2140	2120-2130 2130-2140	9.5 4.6	blk shale; very well consolid; efferv strongly in 10% hcl; slightly fissile; smooth, breaks irregularly.
	2140-2160	2140-2150 2150-2160	8.4 3.2	blk shale; very well consolid; efferv slightly in 10% hcl; moderately fissile; smooth, breaks irregularly. Blk shale; moderately consolid; efferv slightly in hcl, slightly fissile, breaks irregularly.
	2160-2170	2160-2170	6.2	blk shale; well consolid; efferv slightly in hcl; slightly fissile; breaks unevenly, smooth
	2170-2180	2170-2180	2.2	55% med gray l.s. and 45% blk shale; does not efferv in 10% hcl; slightly fissile, breaks irregularly
	2180-2190	2180-2190	2.2	65% med gray l.s.; 30% blk shale; 5% white calcite; slight efferv in hcl; slightly fissile; breaks irreg.
	2190-2200		2.9	85% med gray l.s.; 10% blk shale; 5% white calcite; slight efferv in hcl; fine to med grained texture
	2200-2210		6.4	45% dk gray l.s.; 45% med gray l.s.; 5% white calcite; 5% brwnish red sand grains; does not efferv in hcl
	2210-2220		5.2	30% dk gray l.s., 30% med gray l.s., 30% lt gray l.s., 5% white calcite, 5% reddish brwn sand, no efferv in hcl
	2220-2230		5.4	10% dk gray l.s., 40% med gray l.s., 40% lt gray l.s., 5% white calcite, 5% blk shale, slight efferv in hcl; fine to med texture
	2230-2240		4	30% dk gray l.s., 30% med gray l.s., 30% lt gray l.s., 10% white calcite, well consolidated, slight efferv in hcl
	2240-2250		4.2	40% dk gray l.s., 40% med gray l.s., 20% lt gray l.s., slight efferv in hcl; fine to coarse grained chips
	2250-2260		4.6	40% dk gray l.s., 30% med gray l.s., 30% lt gray l.s., slight efferv in hcl; fine to coarse grained chips
	2260-2270		4.5	40% dk gray l.s. dolomite (?), 30% med gray l.s. dolomite (?), 30% lt gray l.s. dolomite (?), minimal efferv in hcl; fine to coarse grained chips
	2270-2280		4.8	40% dk gray l.s. dolomite (?), 30% med gray l.s. dolomite (?), 30% cream colored l.s. dolomite (?), minimal efferv in hcl; fine to coarse grained chips
	2280-2290		5	40% dk gray l.s. dolomite (?), 30% med gray l.s. dolomite (?), 30% cream colored l.s. dolomite (?), minimal efferv in hcl; med to coarse grained chips

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	2290-2300		5.1	40% dk gray l.s.or dolomite, 30% med gray l.s. or dolomite, 30% lt gray l.s. dolomite (?), minimal efferv in hcl; med to coarse grained chips
	2300-2310		5.2	50% cream colored dolomite, 30% lt gray dolomite, 20% gray dolomite, minimal efferv in hcl; chips coarse 4.8 - 2.0 mm
beginning of injection zone	2310-2320		5.1	60% cream colored dolomite, 30% lt gray dolomite, 10% gray dolomite, minimal efferv in hcl; chips coarse 4.8 - 2.0 mm
Took core from 2318' to 2327' kb (9'); recovered 6' of core	0'(bottom)			med to dk gray l.s.; crystalline; well indurated; efferv readily in hcl; massive (likely dolomite)
	5'			med gray l.s.; crystalline; well indurated; efferv in hcl; massive (likely dolomite)
Back to Drilling	2330-2340		1.8	50% dk gray l.s., high efferv in 10% hcl; 30% light gray dolomite; 20% blk l.s.; chips 70% formation and 30% cement
	2340-2380	2340-2350 2350-2360 2360-2370 2370-2380	4.0 4.0 5.1 5.0	95% cream colored dolomite; 5% blk l.s.; chips fine to medium .08 - 2.0 mmm 95% cream colored dolomite; 5% white dolomite; chips fine to medium .08 - 2.0 mm
	2380-2390		9.7	95% lt gray dolomite w/ 5% white calcite chips; fine to medium grained; well indureated; efferv in 10% hcl
	2390-2400		11	95% lt gray dolomite w/ 5% blk shale chips; fine to medium grained; well indurated; efferv in 10% hcl
	2400-2410		9	90% lt gray dolomite w/ 10% blk shale flecks; fine to medium grained; well indurated; efferv in 10% hcl
	2410-2420		9.4	85% med gray l.s., 10% lt gray l.s., 5% blk shale flecks; fine to medium grained; well indurated; slight fizz in 10% hcl
	2420-2430		9.2	85% med gray l.s., 10% lt gray l.s., 5% blk shale flecks; fine to medium grained; well indurated; slight fizz in 10% hcl
	2430-2440		8.2	60% lt gray l.s. w/35% med gray l.s. and 5% blk shale flecks; fine to medium grained; well indurated; slight fizz in 10% hcl
	2440-2450		5	60% lt gray l.s. w/35% med gray l.s. and 5% blk shale flecks; fine grained; mod indurated; slight fizz in 10% hcl

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	2450-2460		4.8	60% lt gray l.s. w/30% med gray l.s., 5% white calcite chips, and 5% blk shale flecks; fine to medium grained; mod indurated; little to no fizz in 10% hcl
	2460-2470		4.2	60% lt gray l.s. w/30% med gray l.s., 5% white calcite chips, and 5% blk shale flecks; fine to medium grained; mod indurated
	2470-2480		4.3	70% lt gray l.s. w/20% med gray l.s., 5% white calcite chips, and 5% blk shale flecks; fine to medium grained; mod indurated
	2480-2490		4.8	80% lt gray l.s. w/15% med gray l.s., 5% white calcite chips; fine to medium grained

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	2490	2490-2500	6.0	85% lt. grey limestone w/ 15% fine-coarse grained black shale chips v. well indurated, fizzes in 10% HCL
		2500-2510	5.2	lt. grey dolomite w/ ~5% black shale flecks, fine-med. Grained , v. well indurated, strongly fizzes in 10% HCL
		2510-2520	5.4	lt. grey dolomite w/ ~5% black shale flecks, fine-med. Grained , v. well indurated, fizzes in 10% HCL
		2520-2530	5.6	lt. grey dolomite w/ 5% black shale flecks, fine-med. Grained, well indurated, fizzes in 10% HCL
		2530-2540	5.2	lt. grey dolomite w/ 5% black shale flecks, fine-med. Grained, well indurated, fizzes in 10% HCL
		2540-2550	4.0	lt. grey dolomite w/ 5% black shale flecks & 2% white calcite chips, fine-med. Grained, mod. Indurated, fizzes in 10% HCL
		2250-2560	5.0	lt. grey dolomite w/ 5% black shale flecks & 2% white calcite chips, fine-med. Grained, mod. Indurated, fizzes in 10% HCL
		2560-2570	4.2	Medium grey dolomite w/ 10% lt. grey dolomite chips, fine-med. Grained, well indurated, fizzes strongly in 10% HCL
		2570-2580	4.5	Medium grey dolomite w/ 10% lt. grey dolomite chips, fine-med. Grained, well indurated, fizzes strongly in 10% HCL
		2580-2590	3.9	Medium grey dolomite w/ 10% lt. grey dolomite chips, fine-med. Grained, well indurated, fizzes strongly in 10% HCL
		2590-2600	4.1	Medium grey dolomite w/ 10% lt. grey dolomite chips, fine-med. Grained, well indurated, fizzes strongly in 10% HCL
		2600-2610	4.1	Medium grey dolomite w/ 10% lt. grey dolomite chips, fine-med. Grained, well indurated, fizzes strongly in 10% HCL

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		2610-2620	3.6	lt. grey dolomite w/ 5% black shale flecks & 5% white calcite chips, fine-med. Grained, med. Indurated, fizzes in 10% HCL
		2620-2630	3.7	lt. grey dolomite w/ 5% black shale flecks & 5% white calcite chips, fine-med. Grained, med. Indurated, fizzes in 10% HCL
		2630-2640	4.2	lt. grey dolomite w/ 5% black shale flecks & 5% white calcite chips, fine-med. Grained, med. Indurated, fizzes in 10% HCL
	2650	2640-2650	4.3	80% lt. grey dolomite / 10% white dolomite / 10% white calcite chips, fine-coarse, moderate reactivity in 10% HCL
		2650-2660	3.6	80% lt. grey dolomite / 15% white dolomite / 5% white calcite chips, fine-coarse, moderate reactivity in 10% HCL
		2660-2670	4.0	60% lt. grey dolomite / 35% white dolomite / 5% white calcite chips, fine-coarse, moderate reactivity in 10% HCL
		2670-2680	4.1	70% white dolomite / 35% grey dolomite / 5% white calcite chips, fine-med., strong reactivity in 10% HCL
NOTES: Foam from soap is active from 2680' to 2740' chip size is likely the result of faim generated from soap.	2680	2680-2690 2690-2700 2700-2710	3.1 3.2 3.7	95% lt. grey dolomite limestone with 5% calcite chips, medium-coarse chips, slight reactivity in 10% HCL
	2710	2710-2720 2720-2730	2.8 3.0	98% lt. grey dolomite limestone w/ ~ 2% calcite chips, med.-coarse chips, slight reactivity in 10% HCL
	2730	2730-2740	4.9	90% lt. grey dolomite limestone, 5% grey dolomite limestone, 5% calcite chips, fine-med. Chips, slight reactivity in 10% HCL
	2740	2740-2750	3.9	70% lt. grey dolomite limestone, 30% grey dolomite limestone, fine-coarse chips, reactivity in 10% HCL
	2750	2750-2760 2760-2770	4.8 2.6	60% dark grey dolomite limestone, 35% grey dolomite limestone, 5% calcite, fine-med. Chips, reactive in 10% HCL

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	2780	2770-2780 2780-2790	2.5 3.4	Dolomite, 80% lt. grey to 15% dark grey , <5% calcite
	2790	2790-2800 2800-2810	5.2 10.4	Dolomite lt. grey, minor reaction to 10% HCL, minor calcite
	2810 - 2820	2810-2820	10.0	Dolomite limestone, ~90% lt. grey, 10% dark grey, reactive to 10% HCL
	2820 - 2830	2820-2830	4.8	Dlolmite limestone, white (~ 30%) to grey, minor reaction to HCL (10%)
	2830 - 2840	2830-2840	6.2	Dolomite limestone, white (~40%) to grey, minor reaction to 10% HCL, cuttings coarser chips
	2840 - 2850	2840-2850	6.0	Dolomite, grey (~70%) to white, little reaction to 10% HCL
	2850 - 2880	2850-2860 2860-2870 2870-2880	3.3 6.8 6.1	Dolomite limestone, lt. grey to grey (~70%), white, cuttings chips finer grained, minor reaction to HCL
	2880 - 2910	2880-2890 2890-2900 2900-2910	5.1 4.6 5.0	Dolomite limestone, grey (~80%), lt. grey, cuttings chips coarse 4.8-2.0mm, minor reaction to 10% HCL
	2910	2910-2920		Dolomite limestone, dark grey (~70%), lt. grey, cuttings chips coarse 4.8-2.0mm, minor reaction to HCL 10%
NOTES: Fax to 713-468-4956	2920 - 2940	2923-2938	5.9	Dolomite limestone, 85% dark grey , 15% lt. grey, cuttings chips fine, moderate reaction to 10% HCL
	2940 - 2950	2940-2950	14.2	Dolomite limestone ~70% lt. grey, 30% dark grey, cuttings chips mod., minor reaction to 10% HCL
	2950 - 2960	2950-2960	11.8	Dolomite ~75% lt. grey, 25% grey-dark grey, cuttings chips coarse - v. caorse (1/4-3/8")
	2960 - 2970	2960-2970	14.5	Dolomite, ~60% dark grey, 40% lt. grey, cuttings chips coarse to v. coarse
	2970 - 2990	2970-2980 2980-2990	5.3 7.0	Dolomite, ~80% grey-dark grey, 20% white cuttings chips mod.-coarse
	2990 - 3000	2990-3000	5.0	Dolomite, ~60% grey-dark grey, 40% lt. grey

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	3000 - 3030	3000-3010 3010-3020 3020-3030	5.1 5.1 3.0	Dolomite limestone, ~60% grey-dark grey, 40% lt. grey, mod.-high reaction to 10% HCL
	3030 - 3070	3030-3040 3040-3050 3050-3060 3060-3070	5.8 5.2 7.0 6.0	Limestone, ~70% lt grey, 40~ dark grey. High reaction to hcl. Cuttings fine to medium.
	3070 - 3100	3070-3080 3080-3090 3090-3100	6.3 6.0 4.6	Dolomite limestone, ~80% light grey, 20% dark grey. Moderate reaction to hcl. Cuttings fine to medium.
	3100 - 3130	3100-3110 3110-3120 3120-3130	4.9 4.8 5.4	Dolomite limestone, ~60% light grey, 40% dark grey. Moderate reaction to hcl. Cuttings fine to medium.
	3130 - 3140	3130-3140	3.8	Dolomite limestone, ~60% dark grey, 35% light grey, 5% calcite chips. Reactive to hcl. Cuttings fine to medium.
	3140 - 3160	3140-3150 3150-3160	7.0 7.7	Dolomite ~60% med grey, 40% light grey, 5% non-reactive light grey. Mild/moderate reaction to hcl. Cuttings fine to medium.
	3160 - 3180	3160-3170 3170-3180	7.8 7.6	Dolomite ~80% grey, 20% non-reactive light grey. Mild reaction to hcl. Cuttings fine to very fine.
	3180 -	3180-3190	4.7	Dolomite ~80% grey, 20% non-reactive light grey. Mild reaction to hcl. Cuttings fine to very fine.
NOTES: Sample collecting has been variable. When discharge low, e.g. after making a connection, we get (mostly undentifiable) fine fraction. When discharge hihg, get coarse fraction & no fines, fines generally brown calcerous.	3190 - 3210	3190-3200 3200-3210	8.8 8.1	Dolomite l.s.; ~80% grey, 15% non-reactive light grey; 5% blk crystalline nonreactive. Mild reaction to hcl. Cuttings very fine to medium.
	3210 - 3220	3210-3220	10.7	Dolomite l.s.; 75% grey-brown, 22% coarse non-reactive light grey; 3% blk crystalline nonreactive. Mild reaction to hcl. Cuttings fine to medium.
	3220 - 3250	3220-3230 3230-3240 3240-3250	6.1 6.1 5.3	Dolomite l.s.; ~60% grey-green, 30% light grey; 5% grey; 5% blk crystalline. Reactive to 10% hcl. Cuttings fine to medium.

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	3250 - 3270	3250-3260 3260-3270	4.8 5.9	Dolomite l.s.; ~60% grey-green, 30% light grey; 5% grey; 5% blk crystalline. Reactive to 10% hcl. Cuttings fine to medium.
	3270 - 3300	3270-3280 3280-3290 3290-3300	4.7 5.2 5.4	Dolomite l.s.; ~80% light grey, 28% grey; 2% calcite chips. Reactive to 10% hcl. Cuttings fine to medium.
	3300 - 3310	3300-3310	5.3	Dolomite l.s.; ~85% grey-green, 15% grey. High reaction to 10% hcl. Cuttings fine to medium.
	3310 - 3330	3310-3320 3320-3330	4.4 6.3	Dolomite l.s.; ~70% dark grey, 25% light grey; 5% calcite chips. Moderate reaction to 10% hcl. Cuttings fine to medium.
	3330 - 3340	3330-3340	5.9	Dolomite l.s.; ~70% grey-green, 30% grey. High reaction to 10% hcl. Cuttings fine to medium.
	3340 - 3350	3340-3350	8.1	Dolomite l.s.; ~70% grey-green, 30% light grey. High reaction to 10% hcl. Cuttings fine (small sample).
	3350 - 3360	3350-3360	7.0	Dolomite l.s.; ~80% light grey, 18% creamish grey; ~2% angular - subangular, medium 1.0 - .43 black and white pieces, poss. Quartz ?
	3360 - 3370	3360-3370	6.2	rock type unknown ; cuttings 80% fine (brwn, lt grey, tan, black - maybe some lithic fragments - shaled l.s. - also poss. Feldspar?) 15% very coarse l.s. fragments; 5% coarse blk shale.
	3370 - 3380	3370-3380	7.6	Mixed lithology; 70% fine - med. Cuttings (brwn, lt grey, tan, blk); 30% coarse cuttings; limestone and minor sandstone fragments (sandstone is very fine to fine grained, calc. cement -- poss. Surface contamination due to sample collection method)
	3380 - 3400	3380-3390 3390-3400	7.8 8.2	See 3360 - 3370

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NOTES: Sample collecting has been variable. When discharge low, e.g. after making a connection, we get (mostly undentifiable) fine fraction. When discharge hihg, get coarse fraction & no fines, fines generally brown calcerous.	3400 - 3410	3400-3410	6.4	Mixed lithology; 70% fine - med. Cuttings (brwn, lt grey, tan, blk); 30% coarse cuttings (grey and light grey limestone, dark grey non-hcl reactive fragmentss, minor tan ss)
	3410 - 3440	3410-3420 3420-3430 3430-3440	5.9 5.4 4.8	Mixed lithology; 75% fine - med. Cuttings (brwn, lt grey, tan, blk) reactive to Hcl; 25% coarse cuttings (mostly l.s., some tan ss, calcite and minor shale)
	3440 - 3460	3440-3450 3450-3460	5.5 5.2	Mixed lithology; 85% fine cuttings (brown, lt. grey, tan, black) reactive to HCL; 15% mod. Coarse cuttings (fine-grained tan ss, light grey ls)
	3460 - 3490	3460-3470 3470-3480 3480-3490	6.0 5.8 6.1	Dolomite limestone; 90% greenish grey; 10% lt. grey; highly reactive to HCL 10% chips med.-coarse
	3490 - 3510	3490-3500 3500-3510	7.8 8.0	Dolomite limestone; 60% white; 40% black, moderate reaction to 10% HCL, chips med.-coarse
	3510 - 3530	3510-3520 3520-3530	7.0 6.6	Dolomite limestone; 70% black; 40% grey, moderate reaction to 10% HCL, chips fine-med.
	3530 - 3540	3530-3540	6.5	Dolomite limestone; ~ 70% white; 30% black, moderate reaction to 10% HCL, chips med.-coarse
	3540 - 3550	3540-3550	6.3	Dolomite limestone; 70% dark grey; 30% grey, hihg reaction to 10% HCL, chips fine-med.
	3550 - 3560	3550-3560	3.5	Dolomite; dark grey ~ 60%, limestone, lt. grey ~ 30% Dolomite, white ~ 10%. Dol D.G and white, slightly reactive. limestone lt. grey, highly reactive cuttings coarse-med.
	3560 - 3570	3560-3570	5.7	Dolomite, light to dark grey ~ 83%. Limestone, light grey ~ 10% chert, black 5%, med. Grained feldspare or quartz ~2%, cuttings med. - v. coarse
	3570 - 3600	3570-3580 3580-3590 3590-3600	6.0 5.8 6.9	Dolomite, light to olive grey 90%; limestone, grey to light grey, 10% cuttings med. - v. coarse

JOHN SHOMAKER AND ASSOCIATES, INC.
JDF INJECTION TEST WELL NO. 1
UNITED DRILLING, INC. RIG 5
LITHOLOGY LOG

NOTES	DEPTH, FT.	INTERVAL FEET	PENETRATION RATE / MIN.	DESCRIPTION
NOTES: After connection returns are weak for 15-25 mins. When the borehole unloads discharge is violet. Samples are taken when the safety of the crew allows, samples sizes from 3640' down are relativly small.	3600 - 3620	3600-3610 3610-3620	7.2 7.1	NO SAMPLE; NO DISCHARGE SINCE LAST CONNECTION NO SAMPLE; DISCHARGE TOO VIOLENT TO SAMPLE
	3620 - 3630	3620-3630	6.8	90% dolomite, light grey to dark grey; 10% limestone, grey, cuttings med.-coarse
	3630 - 3640	3630-3640	7.1	NO SAMPLE; NO DISCHARGE SINCE LAST CONNECTION
	3640 - 3650	3640-3650	6.8	Limestone; ~80% light grey, 20% white, High reactivity to 10% HCL cuttings, med.-coarse
	3650 - 3680	3650-3660 3660-3670 3670-3680	6.1 5.6 5.2	Dolomite limestone; ~60% black, 20% grey, 20% white(minor calcite) mild reaction to 10% HCL, cuttings med.-coarse
	3680 - 3710	3680-3690 3690-3700 3700-3710	7.0 5.0 7.0	Dolomite limestone; ~40% black, 40% grey, 20% white(minor calcite) mild reaction to 10% HCL, cuttings med.-coarse
	3710 - 3740	3710-3720 3720-3730 3730-3740	4.6 4.0	Dolomite limestone; ~60% grey, 20% light grey, 20% black, mild reaction to 10% HCL, cuttings med.-coarse
	3740 - 3750	3740-3750	9.0	Dolomite limestone; ~80% light grey, 18% grey, 2% clacite, veins in chips, mild reaction to 10% HCL, cuttings med.-coarde
	3750 - 3760	3750-3760	7.4	Mixed lithology; 90% fube-grained cuttings (brown, tan, grey, black, calcareous); 7% v. coarse cuttings (grey dolomite); 3% med.-coarse tan sandstone fragments
	3760 - 3770	3760-3770	10.0	Dolomite limestone; ~80% light grey, 18% grey, 2% clacite, veins in chips, mild reaction to 10% HCL, cuttings med.-coarse

EPWU Test Hole 1

TETRA TECH NUS, INC.
Houston, Texas

RECORD OF WELL CONSTRUCTION
TEST/PILOT HOLE INVESTIGATION
FORT BLISS, EL PASO COUNTY, TEXAS

WELL NO.: TH01
DRILLER: Stewart Brothers Drilling Co.
DRILLING METHOD: Failing CF-2500 Mud Rotary
DEVELOPMENT METHOD: Swab

CLIENT: Corps of Engineers
PROJECT NUMBER: N7551.327D
DATES INSTALLED: 03/11/03-08/22/03
FIELD GEOLOGISTS: Basilio, Jorgeson, Gaylor, Sosa

WELL DATA

BORE HOLE

DIAMETER: 8 3/4 IN. FROM 0 TO 686 FT.
6 1/4 IN. FROM 686 TO 2300 FT.
5 1/8 IN. FROM 2300 TO 3095 FT.

CASING

TYPE: STEEL
DIAMETER: 6 5/8 IN. LENGTH: 686 FT.
INTERVAL: FROM 0 TO 686 FT.

SCREEN

TYPE: NO WELL SCREEN - OPEN HOLE COMPLETION
SLOT: NA
DIAMETER: NA LENGTH: 2409 FT.
INTERVAL: FROM 686 TO 3095 FT.

SURFACE COMPLETION

TYPE: 4'X4'X6" REINFORCED CONCRETE PAD WITH BOLTDOWN COVER

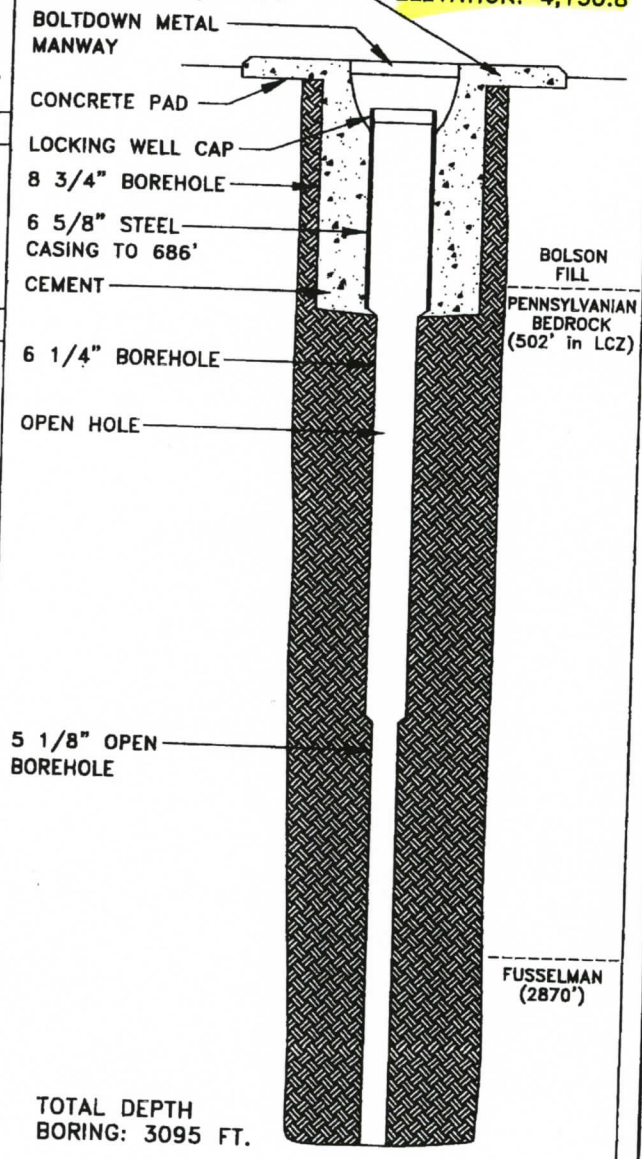
GROUT

TYPE: NEAT CEMENT, NO ADDITIVES
QUANTITY: 168 SACKS, NO RETURNS
INTERVAL: FROM 0 TO 686 FT.

COMMENTS

DRILLED TO REVISED TD OF 2300 FT. ON 03/31/03. RE-ENTERED WELL ON 07/29/03 AND DRILLED TO 3095 FT.

NORTHING: 891,160.84
EASTING: 208,973.16
GROUND SURFACE ELEVATION: 4,130.8



TOTAL DEPTH BORING: 3095 FT.

Not to Scale

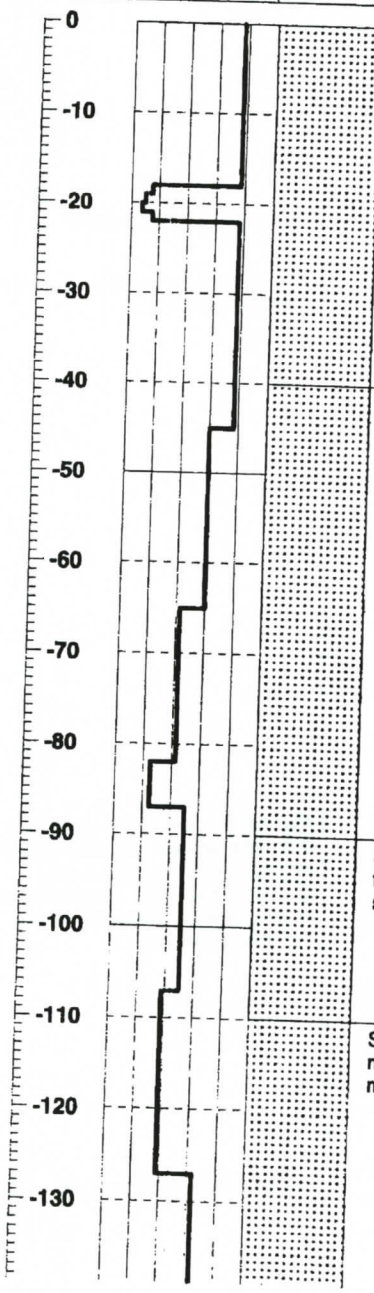
TETRA TECH NUS, INC.
Houston, Texas

BOREHOLE No.: TH01

NORTHING: 891,160.8 feet
EASTING: 208,973.2 feet ELEVATION: 4030.8 feet MSL

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Test/Pilot Hole Investigation**	DRILLING CO.:	**Stewart Brothers Drilling**
SITE LOCATION:	**Fort Bliss, El Paso County, TX**	DRILLER:	**S. Odom/J. Brunson**
JOB NO.:	**N7551 327D**	RIG TYPE:	**Failing CF-2500**
LOGGED BY:	**Tetra Tech NUS, Inc.**	METHOD OF DRILLING:	**Mud Rotary**
PROJECT MANAGER:	**Mike Meenan**	SAMPLING METHODS:	**Drill cuttings & one core**
DATES DRILLED:	**03/11/03 - 08/22/03**	TOTAL DEPTH:	**3,095 feet bgs**

NOTES: All color references are to the Munsell Color Chart.
Re-entered and deepened from 2300 to 3095 ft on 7/28-8/22

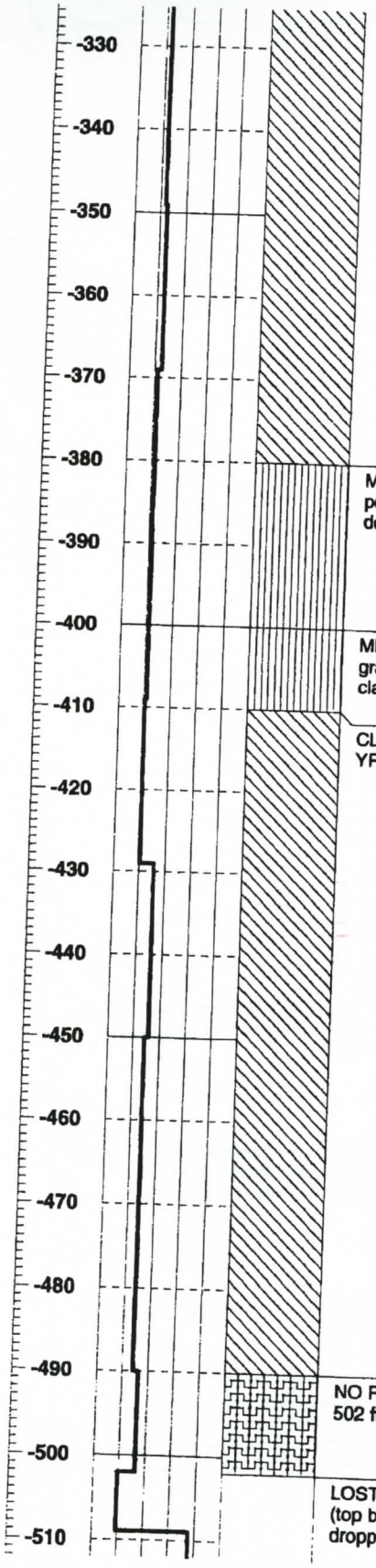


LITHOLOGY DESCRIPTION	REMARKS
SW: SAND - medium to light brown, medium to fine grained, subangular to rounded, poor to moderately sorted; with surface caliche gravel up to 1/2-inch, white (10 YR 8/2), subangular to rounded, 30%. All color references are to Munsell Color Chart.	Begin drilling 0300 hr on 03/11/03. Hole size is 7 7/8-inch using a tricone tungsten carbide insert button bit.
SW: SAND - medium to light brown, medium to fine grained, quartz 80%, feldspar 10%, moderately sorted, trace dark minerals; caliche gravel up to 1/4-inch, white (10 YR 8/2), subangular to rounded, 10%.	Deviation = 0.25 deg at 60'.
SW: SAND - medium to light brown, quartz 75 - 80%, feldspar 15 - 20%, medium to fine grained, moderately sorted, trace caliche gravel, trace dark minerals.	
SW: SAND - medium brown, quartz 80%, feldspar 20%, medium to fine grained, moderately sorted, trace of mica, dark minerals and caliche.	Deviation = 0.125 deg at 107'.

BOREHOLE No.: TH01

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-140				
-150				
-160				Deviation = 0.125 deg at 160'.
-170			SW: SAND - medium brown, quartz 80%, feldspar 15%, trace dark minerals 5%, fine grained, poorly sorted, subrounded to rounded.	
-180			SW: SAND - medium brown, quartz 70%, feldspar 30%, trace dark minerals, coarse to fine grained, poorly sorted, subangular to subrounded, trace caliche.	
-190			SW: SAND - light brown, quartz 80%, feldspar 20%, trace dark minerals, very fine to fine grained, moderately sorted, subrounded to rounded, trace caliche.	
-200				Deviation = 0.0 deg at 200'.
-210			CL: CLAY with fine sand, brown (7.5 YR 5/4), sand is 80 to 90% quartz with minor feldspar and dark minerals, sand is moderately to well sorted and subangular to subrounded, clay is plastic; minor white caliche grains at 220 to 240 ft.	Probable top of lacustrine bolson fill clastic sediments.
-220				
-230				
-240			CL: CLAY and SILT - brown, with 10 to 20% very fine to fine subangular to subrounded poorly sorted sand, sand grains are 80 to 90% quartz with minor feldspar and 1 to 2% dark minerals.	
-250				
-260			CL: CLAY - brown with minor 5 to 10% silt and very fine poorly sorted subrounded to subangular grains.	
-270			CL: CLAYEY SILT and very fine subangular poorly sorted sand dominated by quartz (70 to 80%) and feldspar, occasional clast of very fine grained quartz dominated sandstone, pink (7.5 YR 7/4) to light brown (7.5 YR 6/4).	Mud temperature (MT) = 70.7 F at 270'. (All temperatures measured in degrees Fahrenheit at the mud discharge point from the open hole diverter pipe or, if cased, from the top of the casing).
-280				
-290				
-300			CL: SILTY CLAY - Light brown (7.5 YR 6/3), clay is 60 to 70%of sample, with 25 to 30% very fine to fine poorly sorted subangular to subrounded sand dominated by quartz and feldspar with minor heavy minerals.	
-310				Deviation = 0.125 deg at 309'.
-320				

BOREHOLE No.: TH01



DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
				Deviation = 0.125 deg at 349'.
				MT = 76.1 F at 370'.
-380			ML: CLAYEY SILT with minor very fine to fine grained, poorly sorted, subangular to subrounded quartz dominated sand grains.	
-400			ML: CLAYEY SILT with 5% 5 to 8 mm subangular dark gray green clasts and 4 to 6 mm rounded dark gray clasts.	
-410			CL: CLAY to CLAYEY SILT - light yellowish brown (10 YR 6/4), very few sand size clasts.	Deviation = 0.125 deg at 409'.
				MT = 77.6 F at 440'.
-450				Deviation = 0.125 deg at 450' on 03/11.
				Lose circulation (LC) while reaming at 450 feet at 0245 hr on 03/14.
				MT = 78.6 F at 480'.
-490			NO RECOVERY: No drill cuttings recovery from 490 - 502 ft interval.	Geophysical tools unable to get below 476' on 03/14 at 1320 hr.
-500			LOST CIRCULATION: Total loss of circulation at 502' (top bedrock) at 2200 hr on 03/11. Mud pit level dropped approximately 2'. Added cottonseed hulls lost	Top Pennsylvanian bedrock at 502'.
				Drilling at 509 ft at 0000 hr on 3/12.

BOREHOLE No.: TH01

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
			circulation material (LCM) at 0630 hr on 03/12.	
-520			LOST CIRCULATION: Resumed drilling "blind" with no mud returns at 0730 hr on 03/12.	
-530			LOST CIRCULATION: Drilled blind to 667' at 1700 hr on 03/12. Drill rates indicate boring is in limestone bedrock. Chert and limestone fragments observed in drill bit jets when trip out of hole at 669' also indicate bedrock.	
-540				
-550				MW = 9.3 pound per gallon (ppg).
-560				
-570				
-580				
-590				
-600				
-610				
-620				
-630				Trip in hole at 0700 hr on 03/13 to prepare boring for geophysical logging.
-640				
-650				Began reaming hole from 7 7/8-inch to 8 3/4-inchs at 2140 hr on 03/13/03 with full circulation.
-660				
-670			LOST CIRCULATION: No returns. Reamed blind from 669 to 686'. Geophysical logging tools unable to get below 551' on 03/13. Open hole interval 686 to 551 feet could not be logged. Decision to set casing at 686' made on 03/13.	6 5/8 inch OD casing set at 686' on 03/14.
-680				Cemented casing with 5 cubic yards at 0730 hr on 03/15. No cement returns. Cementing plug set at 665'. Added 3 yards cement "backside" at 1300 hr. No returns.
-690			LOST CIRCULATION: Set casing and resumed drilling. No returns until 690'.	
			LIMESTONE: Light gray (10 YR 5/1), 70%, dark gray	MT = 77.0 F at 695'.

BOREHOLE No.: TH01

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-700			(GLEY 2.5) broken angular fragments to 1/4 inch, moderate dark brown staining on light fragments, trace clear angular calcite crystals embedded on fragments, poorly sorted, small vugs.	Deviation = 0.25 deg at 706'.
-710				Century ran cement bond log (CBL), neutron and gamma gamma logs on 03/16.
-720			LIMESTONE: Gray to dark gray (10 YR 4/1-6/1), 20%, light brown to dark grown 30%, subangular fragment to 1/4 to 1/2-inch, poorly sorted, reactive with HCl; CLAY, orange to light brown, 50%, reacts with HCl.	Drilled out rubber cementing plug at 655' at 0550 hr on 03/16. Top cement at 670'. Drilled out cementing shoe at 686' at 0615 hr. Drilled into limestone formation with full returns. Hole size is 6 1/4-inch using tricone tungsten carbide insert button bit.
-730				
-740			LIMESTONE: As above with 5% dark red fragments. Clay is absent.	
-750			LIMESTONE: As above with CLAY, 40%, light brown to orange "clayey mud" .	MT = 81.0 F at 746'.
-760				
-770			LIMESTONE: Gray to grayish brown 2.5 Y 5/1 to 5/2, 75-80%; 5 mm angular chert fragments, reacts with HCl, poorly sorted, 2-3%; fines, reactive, 15-20%	Deviation = 0.375 deg at 766'.
-780			LIMESTONE: Gray to grayish brown (2.5 YR 5/1 to 5/2), 85% 2 to 5 mm subangular limestone fragments with minor dark gray fragments, 10% very fine calcareous silt and clay size material, moderate sorting in larger fragments.	Drilling at 786' at 1150 hr on 03/16/03. MT = 77.0 F at 786'.
-790				
-800			LIMESTONE: As above with 20 to 30% very fine calcareous sand-silt.	
-810			LIMESTONE: As above with 50 - 60% angular to subangular limestone clasts with 40 - 50% fine calcareous silt and clay. More fines than previous samples.	Deviation = 0.5 deg at 806'.
-820				
-830			LIMESTONE: 75 - 85% subrounded limestone clasts with minor quartz. Fines are 15 - 20%. Large fraction is moderately to poorly sorted, fine fraction is well sorted. 2 - 4 % large 7 - 8 mm clasts.	MT = 83.3 F at 826'. MW = 8.7 ppg, viscosity (vis) = 42.
-840			LIMESTONE: Gray, 60 - 70% gray limestone, poorly sorted, occasional quartz clast with minor feldspar.	MT = 83.3 F at 840'.
-850			LIMESTONE: 65% limestone clasts, gray to grayish brown (2.5 YR 5/2 to 5/3), poorly sorted, quartz grains, fine fraction is calcareous silt.	Deviation = 0.5 deg at 847'.
-860			LIMESTONE: Light brown to pinkish gray (7.5 YR 6/3 - 7/2), clay with 45 to 85% angular 5 mm dark gray limestone clasts with depth, 5% silt, minor quartz and feldspar.	
-870				
-880			LIMESTONE: As above with occasional chert fragments	

BOREHOLE No.: TH01

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-890			and light brown clay.	MW = 8.8 ppg, vis = 45.
-900			LIMESTONE: As above with some dark gray to black limestone fragments.	
-910			LIMESTONE: Gray to pinkish gray (7.5 YR 6/1 to 67/3), subangular to angular 80 - 90 % crystalline limestone, <5% silt.	Deviation = 0.5 deg at 907'.
-920				
-930				
-940				
-950			LIMESTONE: As above but with increased silt content, 5 - 10 %. Overall finer grained than previous sample.	Deviation = 0.5 deg at 947'. MW = 8.7 ppg, vis = 41.
-960				MT = 84.8 F at 952'.
-970				
-980			LIMESTONE: Pale yellow (2.5Y 7/2 to 7/3), subangular to subrounded, moderate sorting, 80 - 90% limestone clasts. Definite change in grain size over previous sample.	
-990				MW = 8.7 ppg, vis = 40.
-1000			LIMESTONE: As above with increased silt and clay content, 10 - 20 %.	MT = 85.9 F at 1004'.
-1010				Deviation = 0.75 deg at 1007'.
-1020				Century Geophysical ran Sonic Log on 4/16. Unable to get past 1020 ft. Hole has collapsed at that depth.
-1030			LIMESTONE: Angular to subangular fragments to 6 mm, medium brown to dark gray, moderately sorted, crystalline, silty.	
-1040				MT = 86.8 F at 1036'. Deviation = 0.5 deg at 1048', MW = 9.0 ppg, vis = 33.
-1050			LIMESTONE: As above with trace pyrite.	
-1060			LIMESTONE: Subangular fragments to 4 - 5 mm, medium brown to dark gray, moderately sorted, crystalline, trace pyrite.	Drilling at 1048' at 0000 hr on 03/17.
-1070				

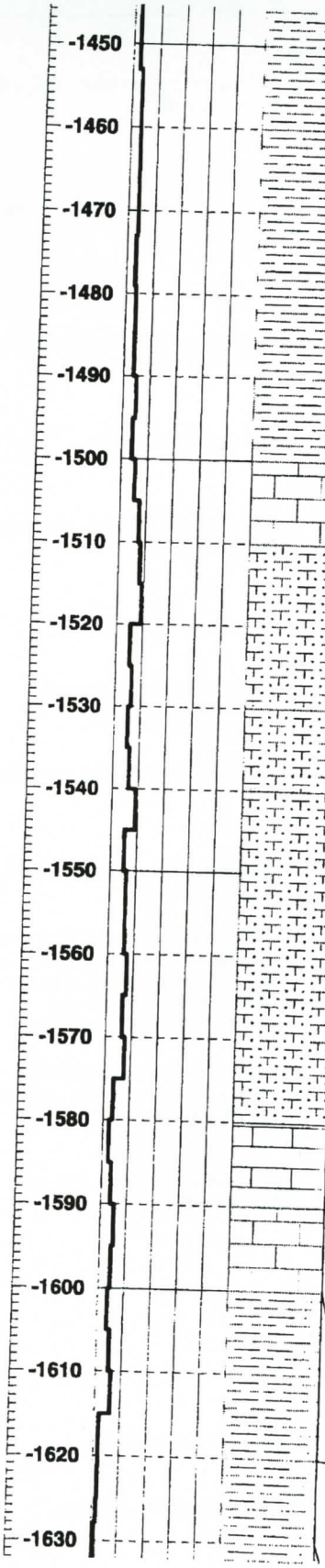
BOREHOLE No.: TH01

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-1080				
-1090			LIMESTONE: Subangular fragments to 4 - 5 mm, light brown to dark gray, moderately sorted, trace pyrite; trace SHALE, black, calcareous.	Water sample interval #5, 1070-1090', at 2200 hr on 04/02. Dry, no sample collected.
-1100			SHALE AND LIMESTONE INTERBEDS: Subangular limestone fragments to 4 - 5 mm, light brown to dark gray, moderately sorted, trace pyrite; SHALE, black, calcareous.	MT = 86.0 F at 1100'.
-1110			SHALE: Black, calcareous, visible partings, trace clasts cemented by calcite consisting of gray limestone fragment and shale, trace pyrite, quartz and mica, poorly sorted; with limestone fragments, as above.	Deviation = 0.5 deg at 1109'. MT = 86.9 F at 1112'.
-1120				
-1130				
-1140				MT = 89.6 F at 1134'.
-1150				MW = 8.8 ppg, vis = 42. Deviation = 0.75 deg at 1150'.
-1160				
-1170				
-1180				
-1190				MT = 93.0 F at 1191'.
-1200				
-1210				Deviation = 1.0 deg at 1210'.
-1220			SHALY LIMESTONE: Black shale fragments with possible bituminous limestone. Minor reaction to HCL. Individual clasts are 1 - 2 mm. Color is dark gray (2.5Y 4/1).	MT = 89.8 F at 1216'.
-1230				MW = 9.2 ppg, vis = 39, RPM = 80.
-1240			SHALY LIMESTONE: Black coarse grained angular to subangular shale fragments. Some large 10 - 20 mm brown plastic clay clasts, dark gray (2.5Y 4/1).	
-1250				Deviation = 1.25 deg at 1252'.

BOREHOLE No.: TH01

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-1260			SHALY LIMESTONE: Black angular to subangular calcareous shale fragments. Some brown plastic clay lumps, 5 - 10 mm.	
-1270			SHALY LIMESTONE: Black calcareous shale or shaley limestone.	MT = 92.3 F at 1270'.
-1280				
-1290				
-1300				
-1310			SHALY LIMESTONE: Black calcareous shale or shaley limestone with 30 - 40% gray clay. Increase in clay fraction from previous samples. Clay is non-reactive with HCL.	MW = 9.0 ppg, vis = 33. Deviation = 1.5 deg at 1313'.
-1320			SHALE/CLAYSTONE: Gray clay matrix, 65 - 70%, with 30 - 35% black calcareous shale clasts. Large increase in finer fraction from previous sample. Less reactive with HCL.	MT = 91.0 F at 1320'.
-1330			SILTSTONE: Very dark grayish brown (2.5 YR 3/2 to very dark gray 2.5Y 3/1). Silty clay with 15 - 20% shale clasts. Not reactive in HCL.	MT = 90.7 F at 1330', MW = 9.0 ppg, vis = 33.
-1340				
-1350			SILTY LIMESTONE: Very dark gray (2.5Y 3/1), clay/silt with 25% clasts of dark gray limestone or clacareous shale. Clasts are angular to subangular and are coarse to medium grained.	MT = 90.0 F at 1352'. Deviation = 1.5 deg at 1353'.
-1360			SHALE: Calcareous, black to dark gray (2.5 Y 2.5/1 to 4/1), visible partings, trace pyrite; with limestone fragments to 5 mm, brown to gray, moderately sorted.	
-1370				
-1380			SHALE: As above, black to dark gray; but sample is lighter in color, with white crystalline calcite (2.5 Y 8/1), subangular to 30%, with limestone fragments 2 to 5 mm, moderately sorted.	Drilling at 1380' at 0000 hr on 3/18.
-1390			SHALE: As above, increasingly lighter in color with increasing percentage white crystalline calcite.	MT = 90.9 F at 1392', MW = 9.1 ppg, vis = 44. Water sample interval #4, 1392-1410', at 1500 hr on 04/02. Dry, no sample collected.
-1400				
-1410			SHALE: As above, darker in color (2.5Y 3/1) with decrease in calcite percentage, trace clay to 5%.	MT = 94.1 F at 1410'. Deviation = 1.75 deg at 1413'.
-1420				
-1430				MT = 90.9 F at 1430'.
-1440			SHALE: As above with increase in white crystalline	

BOREHOLE No.: TH01



DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-1450			calcite (2.5 Y 8/1), and increase in brown to gray limestone to 5%, with trace brown clay.	Deviation = 1.75 deg at 1453'.
-1460			SHALE: Dark gray (7.5 YR 3/1 to gray brown 7.5 YR 5/1 to 4/1), increasing limestone content, subangular, medium to coarse grained size and lighter color, crystalline calcite to 5%.	MT = 96.1 F at 1470'. MT = 94.5 F at 1473'.
-1470				
-1480			SHALE: As above	MT = 95.8 F at 1488'.
-1490				MT = 94.7 F at 1497'.
-1500				Drilled to original proposed TD of 1500' at 1240 hr on 03/18.
-1510			LIMESTONE: Dark gray to black angular to subangular limestone fragments with 40 - 50% brown clay.	Decision made at 1530 hr on 03/28 to continue drilling to 2300' to test the Silurian Fusselman Dolomite Formation, a prospective injection zone.
-1520			CLAYSTONE: Dark gray (7.5 YR 3/3) clay-silt, 60 - 70%, with minor coarse grained angular to subangular light gray limestone clasts. Some brown clay clasts. Clay is slightly reactive with HCL.	Resumed drilling at 1500' at 1100 on 3/19. MW = 8.8 ppg, vis = 37.
-1530				MT = 93.4 F at 1514'.
-1540			CLAYSTONE: As above with 5 - 10 % angular to subangular light gray to tan limestone fragments.	
-1550			CLAYSTONE: Dark gray clay silt, 90 - 95%, with < 5% medium grained 1-2 mm subangular limestone fragments. Very slightly reactive.	
-1560				Deviation = 1.75 deg at 1555'.
-1570				MT = 99.1 F at 1560', MW = 10.0 ppg, vis = 44.
-1580				
-1590			LIMESTONE MUDSTONE: Dark gray limestone clasts, angular to subangular, moderately reactive with HCL, 70%. Brownish limestone clasts10%. Clay, gray, 20%.	
-1600			LIMESTONE: Dark gray black shaley limestone with gray limestone clasts. Increased clay content from previous samples. Clay is brown, soft. All react moderately with HCL.	Deviation = 3 deg at 1616'.
-1610			SHALE: Black calcareous shale, >75%. Flakey, flat, platey clasts, up to 10 mm, angular to subangular, slight to moderate HCL reaction. Some dark gray and brown clay present.	Resumed drilling at 1617' on 03/24 at 2145 hr. Hole size 6 1/4-inches with tricone tungsten carbide button insert bit. MW = 9.1 ppg, vis = 5.
-1620				Water sample interval #3, 1611-1631', at 0630 hr on 04/02. Dry, no sample collected.
-1630			SHALE: Black, calcareous shale, flakey, subangular, bedding planes visible, trace crystalline medium gray limestone and quartz 15%, limestone has strong HCL reaction.	Drilling at 1629' at 0000 hr on 3/25.

BOREHOLE No.: TH01

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-1640			SHALE: As above with increasing limestone to 30% to 40% at 1650 ft, trace quartz. Trace of brown staining on limestone and trace of pyrite at 1640 ft.	MT = 103.7 F at 1626'. MW = 9.0 ppg, vis = 45.
-1650				MT = 104.2 F at 1651'.
-1660				Deviation = 3 deg at 1649'. MW = 9.1 ppg, vis = 38.
-1670				MT = 106.7 F at 1668' at 1055 hr. MW = 9.1 ppg, vis = 42.
-1680			SHALE: As above, with trace to 5% limestone; trace clay, brown	MT = 105.8 F at 1677'.
-1690				MT = 106.6 F at 1694'. MW = 9.2 ppg, vis = 37.
-1700				MT= 106.9 F at 1702'.
-1710				Deviation = 3.5 deg at 1710'.
-1720				MT = 107.8 F at 1714'.
-1730				Drilling at 1726' at 0000 hr on 03/26.
-1740			LIMESTONE: Medium to dark gray (N4-N3), 70%, visible calcite healed fractures, trace pyrite, varying shale content, as above, to 30% (cavings?), trace clay.	Deviation = 8 deg. at 1737'. MW = 9.1 ppg, vis = 36.
-1750				Stopped drilling at 1750' at 0620 hr on 03/26. Re-ran Totco survey every 50' while coming uphole in order to learn where steeper deviation angle increase began.
-1760				Water sample interval #2, 1753 - 1773' at 2335 hr on 04/01. Dry, no sample collected.
-1770				MT = 107.6 F at 1769', MW = 9.2 ppg, vis = 37.
-1780				
-1790			LIMESTONE: As above, medium to dark gray, calcite healed fractures, trace pyrite, varying shale content, as above, to 30% (cavings?), trace clay.	
-1800				MT = 107.5 F at 1805'.
-1810				Deviation = 9 deg. at 1809'.

BOREHOLE No.: TH01

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-1820				MT = 107.2 F at 1815'. MW = 9.2 ppg, vis = 38.
-1830				Drilling at 1830' at 0000 hr on 03/27.
-1840				MT = 109.8 deg. at 1833'.
-1850				Deviation 9.5 deg. at 1850'. MW = 9.1 ppg, vis = 36.
-1860				
-1870				
-1880				MT = 111.8 F at 1876'.
-1890				
-1900				MT = 113.0 F at 1906'.
-1910				Deviation = 9 deg. at 1909'. Drilling at 1909' at 0000 hr on 3/28.
-1920				MT = 106.6 F at 1921'.
-1930				
-1940				
-1950				Deviation = 10 deg. at 1950'.
-1960				MT = 106.6 F at 1960'.
-1970				
-1980			LIMESTONE: As above, medium to dark gray, calcite healed fractures, trace pyrite, varying shale content, as above, to 30% (cavings?), trace clay.	
-1990				MT = 108.9 F at 2001'.
-2000				

BOREHOLE No.: TH01

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-2010				Deviation = 10 deg. at 2010'.
-2020				
-2030				
-2040				Drilling at 2027' at 0000 hr on 03/29.
				MT = 111.1 F at 2040'.
-2050				Deviation = 10 deg. at 2050'.
-2060				Slight loss of circulation at 2056'. Pit dropped 4-inches before stabilizing.
-2070				MT = 114.1 F at 2062'.
-2080				MT = 113.9 F at 2074'. MW = 9.9 ppg, vis = 40.
				Trip for bit at 2080' at 1300 hr on 03/29.
-2090			LIMESTONE: As above with trace noticeable vugs, most vugs are calcite lined.	
-2100				
-2110				Drilling at 2110' at 0000 hr on 03/30.
-2120				
-2130				MT = 114.8 F at 2131'.
-2140				
-2150				
-2160				MT = 115.5 F at 2160'.
-2170			LIMESTONE: As above with increase in dark calcareous shale, trace pyrite.	
-2180				
-2190				

BOREHOLE No.: TH01

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-2200				
-2210				Deviation = 10 deg. at 2210'.
-2220			LIMESTONE AND SHALE INTERBEDS: Black calcareous shale or mudstone with fine rounded gravel and brown clay.	MT = 112.7 F at 2223'.
-2230				
-2240				
-2250				Performed deviation survey at 2250' at 0000 hr on 03/31. Totco instrument stuck in drill collar. Tripped to recover Totco tool. Deviation 10 deg. Worn bit was replaced.
-2260			LIMESTONE: As above. Ran Century Geophysical e-logs in open hole from revised TD (2300') to bottom of the casing (686'). Logged boring with resistivity, temperature, caliper, gamma ray and compensated density-neutron tools.	MT = 108.2 F at 2259'.
-2270				
-2280				
-2290				MT = 105.6 F at 2296'. MW = 9.3, vis = 33.
-2300				Reached revised TD at 2300' at 1630 hr on 03/31. Did not reach objective Fusselman Dolomite.
-2310			LIMESTONE: Dark gray (7.5 YR 4/0) with hues of lighter and darker gray, platey, subangular - subrounded, moderately reactive with HCL, shaley to very shaley, trace tan clasts <1/4", trace white calcite	Re-entered TH01 on 07/29 to drill to Fusselman Dolomite. This decision was based on TH03 reaching Fusselman. Drilled out with 5 1/8" bit.
-2320				Drilling at 2309' at 0000 hr on 07/31.
-2330				
-2340				Stopped drilling at 0255 hr 2335' on 07/31. (Rig moved to TH03 on 08/04 to clear obstructions in borehole for Century Geophysical to run logs.) Returned to TH01 on 08/08.
-2350				
-2360				
-2370				

BOREHOLE No.: TH01

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-2380				
-2390				
-2400				
-2410				
-2420				
-2430				
				Drilling at 2432' at 0000 hr on 08/10.
-2440				
-2450				
-2460				
-2470				
-2480				
-2490				
-2500				Trip for new bit at 2497' at 1330 hr on 08/10.
-2510				
-2520				Drilling at 2518' at 0000 hr on 08/11.
-2530				
-2540				
-2550				
-2560			LIMESTONE AND SHALE INTERBEDS: Medium to dark	

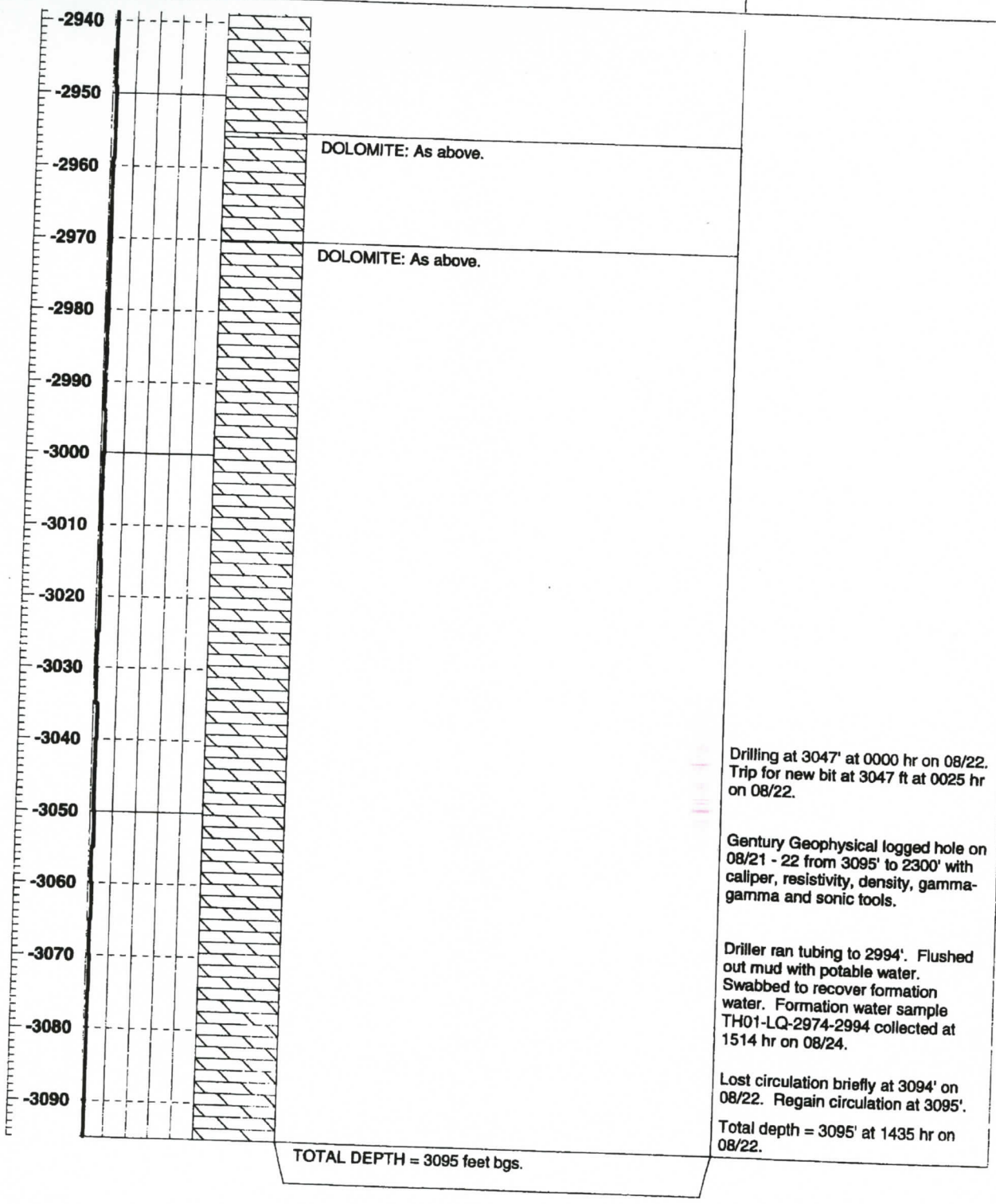
BOREHOLE No.: TH01

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-2570			gray, subangular to subrounded, platey, hard, calcite bandings, moderate to strong HCL reaction, shaley. Shale is dark gray to black. Shale content increases with depth.	
-2580			LIMESTONE AND SHALE INTERBEDS: As above.	
-2590				
-2600				
-2610				
-2620				Drilling at 2618' at 0000 hr on 08/12.
-2630				
-2640				
-2650				
-2660				
-2670				Trip for new bit at 2666' at 1130 hr on 08/12.
-2680				
-2690				Drilling at 2689' at 0000 hr on 08/13.
-2700				
-2710				
-2720				
-2730				
-2740			SHALE: Very dark gray (7.5 YR 3/0) to black (7.5 YR 2/0), subangular to subrounded clasts, platey, elongate to spherical in shape, moderately hard to slightly brittle, dull earthy surface texture, none to very slight reaction	
-2750				

BOREHOLE No.: TH01

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-2760			with HCL.	
-2770				
-2780				
-2790				Depth 2801' at 2300 hr on 08/13. Ran Century gyro tool for hole deviation on 08/14. Maximum deviation 12.0 degrees.
-2800				
-2810				Drilling at 2809' at 0000 hr on 08/19.
-2820				
-2830				
-2840				
-2850			LIMESTONE AND SHALE INTERBEDS: Shale as above; Limestone fragments medium gray (10 YR 7/1 - 5/1) with strong HCl reaction and red color with Alizarin Red Stain.	
-2860				
-2870			DOLOMITE: Light gray (10 YR 7/1), some fragments with lighter and darker hues, some with dark banding, blocky to flakey, subangular to subrounded clasts, fairly uniform and dense, very slight reaction to HCL, reaction increases with time, none to slight red or pink stain with Alizarin Red Stain.	Top Silurian Fusselman Dolomite Formation.
-2880				
-2890				
-2900				
-2910				Pick up 5-inch OD x 3-inch ID conventional core assembly at 2913' on 08/19.
-2920			DOLOMITE: Gray (10 YR 6/1) to dark grayish brown (10 YR 4/2), hard, broken, dense, slightly sugary texture, mostly micritic, very few vugs, mostly fractured from 2913' to 2916' and 2922' to 2926', section from 2916' to 2922' contains small vugs (<1/4-inch) which do not appear connected, some high angle fractures (>45 degrees), calcite filled fractures, very slight reaction in HCL which increases with time, no stain with Alizeran.	Core #1, 2913 - 2926' at 1300 hr on 08/20, 100% recovery.
-2930				Resumed 5 1/8-inch OD rotary drilling at 2235 hr on 08/20. Drilling at 2930' at 0000 hr on 08/21.

BOREHOLE No.: TH01



EPWU Test Hole 2

TETRA TECH NUS, INC.
Houston, Texas

RECORD OF WELL CONSTRUCTION
TEST/PILOT HOLE INVESTIGATION
FORT BLISS, EL PASO COUNTY, TEXAS

WELL NO.: TH02
DRILLER: Stewart Brothers Drilling Co.
DRILLING METHOD: Falling CF-2500 Mud Rotary
DEVELOPMENT METHOD: Air Lift

CLIENT: Corps of Engineers
PROJECT NUMBER: N7551.327D
DATES INSTALLED: 04/09/03-05/09/03
FIELD GEOLOGISTS: Basilio, Jorgeson, Gaylor, Sosa

WELL DATA

BORE HOLE

DIAMETER: 8 3/4 IN. FROM 0 TO 583 FT.
6 1/4 IN. FROM 583 TO 752 FT.
6 IN. FROM 752 TO 972 FT.

CASING

TYPE: STEEL
DIAMETER: 6 5/8 IN. LENGTH: 583 FT.
INTERVAL: FROM 0 TO 583 FT.

SCREEN

TYPE: STEEL
SLOT: 8X3" SLOTTED
DIAMETER: 4 1/2 IN. LENGTH: 389 FT.
INTERVAL: FROM 583 TO 972 FT.

SURFACE COMPLETION

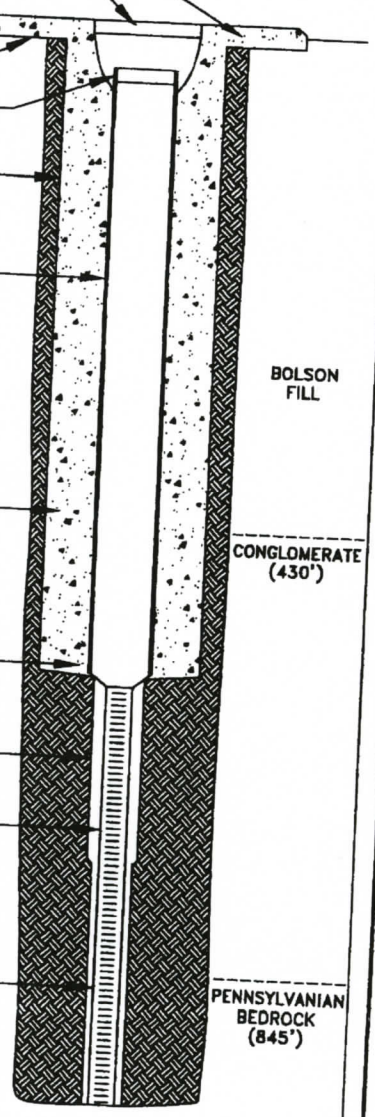
TYPE: 4'X4'X6" REINFORCED CONCRETE PAD WITH BOLTDOWN COVER

GROUT

TYPE: NEAT CEMENT, NO ADDITIVES
QUANTITY: 5 CUBIC YARDS (1 1/2 CUBIC YARDS RETURN)
INTERVAL: FROM 0 TO 583 FT.

COMMENTS

NORTHING: 884,454.48
EASTING: 209,755.82
GROUND SURFACE ELEVATION: 4,151.5



TOTAL DEPTH BORING: 972 FT.

Not to Scale

TETRA TECH NUS, INC.
Houston, Texas

BOREHOLE No.: TH02

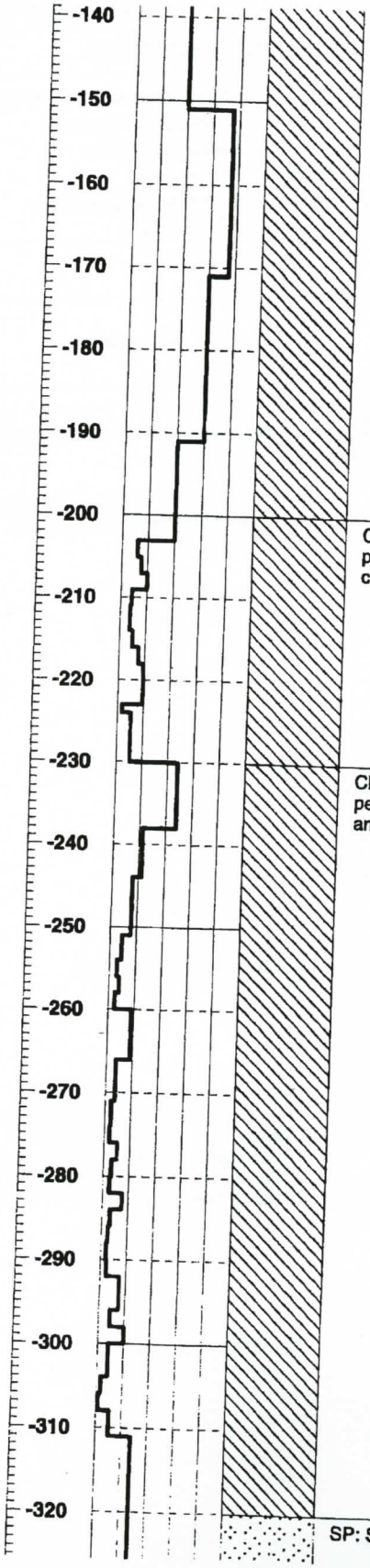
NORTHING: 884,454.48
EASTING: 209,755.82
ELEVATION: 4151.5 Feet MSL

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Test/Pilot Hole Investigation**	DRILLING CO.:	**Stewart Brothers Drilling**
SITE LOCATION:	**Fort Bliss, El Paso County, TX**	DRILLER:	**S. Odom/J. Brunson**
JOB NO.:	**N7551 327D**	RIG TYPE:	**Failing CF-2500**
LOGGED BY:	**Tetra Tech NUS, Inc.**	METHOD OF DRILLING:	**Mud Rotary**
PROJECT MANAGER:	**Mike Meenan**	SAMPLING METHODS:	**Drill cuttings/Cores**
DATES DRILLED:	**04/09/03 - 05/09/03**	TOTAL DEPTH:	**972 feet bgs**

NOTES: All color references are to the Munsell Color Chart.

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
0			SP: SAND - medium to light brown, medium to fine grained, subangular to rounded, poor to moderately sorted; caliche gravel up to 1/4-inch, white (10 YR 8/2), subangular to rounded, 30 percent.	Begin drilling 0410 hr on 04/09/03. Hole Size: 6 1/4-inch using tricone tungsten carbide insert button bit.
-10				
-20				
-30				
-40			SP: SAND - As above, medium to light brown, medium to fine grained, subangular to rounded, poor to moderately sorted; caliche gravel up to 1/4-inch, white (10 YR 8/2), subangular to rounded, 30 percent, increasing dark mineral content to 5-10%, subrounded to rounded and decreasing sample volume.	
-50				
-60				
-70				Deviation = 0.25 deg at 67'.
-80				
-90				Mud temperature (MT) = 62.6 F at 82'. (All temperatures measured in degrees fahrenheit (F) at mud discharge point from either the open hole diverter pipe or, if cased, from the top of the casing).
-100				
-110				Deviation = 0.0 deg at 112'.
-120			SP: SAND - As above, pinkish gray to light brown (7.5 YR 7/2 to 7.5 YR 6/3), fine to medium grained to 5% coarse grained, subangular to subrounded; clasts dominated by quartz with minor granite fragments.	
-130			CL: SILT AND CLAY - light brown (7.5 YR 6/4); plastic	

BOREHOLE No.: TH02

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-140			with 15% sand, fine grained, dominated by subrounded quartz grains.	
-150				Deviation = 0.0 deg at 152'.
-160				
-170				
-180				
-190				
-200			CL: SILT AND CLAY - As above, with increasing higher percentage of fine grained clastics, 25-30%, and coarse grained, subrounded clastics, to 1-2%.	
-210				Deviation = 0.25 deg at 211'. Mud weight (MW) = 8.9 pounds per gallon (ppg), viscosity (vis) = 33.
-220				
-230			CL: SILT AND CLAY - As above, with decreasing percentage of coarse grained clastics and minor amount, 2%, fine grained sand.	
-240				
-250				Deviation = 0.5 deg at 251'.
-260				
-270				MT = 72.9 F at 272'.
-280				MT = 74.2 F at 297'.
-290				
-300				
-310				Deviation = 0.25 deg at 311'.
-320			SP: SAND - light brown (7.5 YR 6/3 - 7/3), fine grained,	

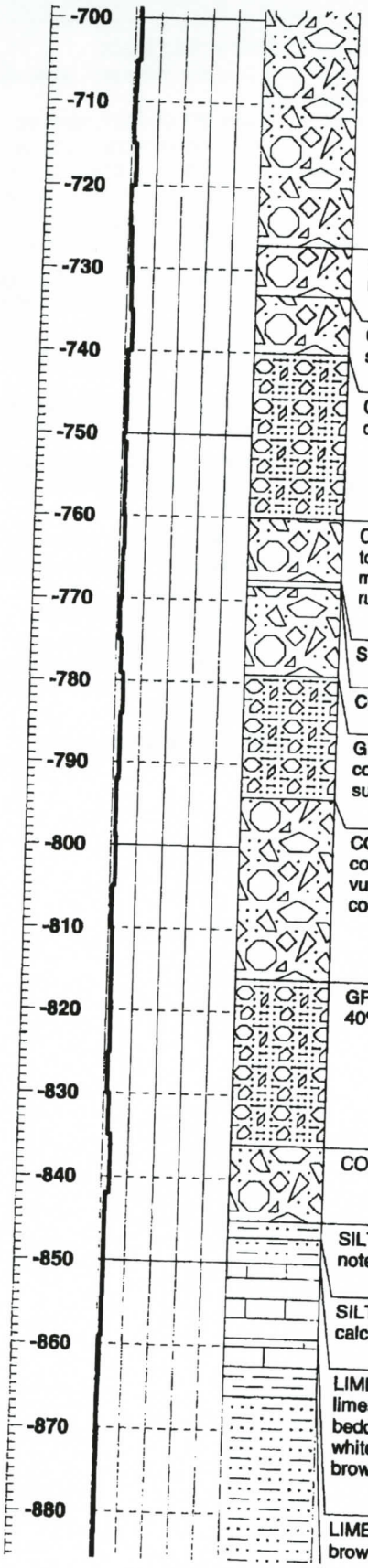
BOREHOLE No.: TH02

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-330			rounded to subrounded, 50 - 60%; coarse fragment of sand and limestone, 20%; calcite, crystalline (7.5 YR 7/4) medium to fine grained, subrounded to subangular, trace dark fragments (igneous ?) rock.	
-340			SP: SAND - As above with increase in coarse fragments (cavings ?).	Drilling at 344' at 0000 hr on 04/10.
-350				
-360				Deviation = 0.5 deg at 353'.
-370				MT = 74.3 F at 383'.
-380				Conditioned hole. Began conventional coring at 390' using 6" OD polycrystalline diamond chip (PDC) core head, core size 4".
-390				Deviation = 0.5 deg at 390'.
-400			SM: SAND - silty, very fine grained, rounded to subrounded, loosely consolidated, poorly cemented, slightly calcareous, brown-medium brown (7.5 YR 5/3-5/6), moderately to well sorted, dry; trace dark (igneous ?) mineral grains.	Core #1, 390-394', 100% recovery (rec). Core #2, 394-396', 50% rec. Core #3, 396-401', 80% rec.
-410			SM: SAND - As above but increasingly consolidated, stiff. Tested interval 420 to 440 feet on 04/13 for water using gravel envelope method. No formation water was recovered.	Core #4, 401-406', 100% rec. Core #5, 406-411', 100% rec. Coring at 411' at 0000 hr on 04/11.
-420				Core #6, 411-424', 100% rec. Water sample interval 420-440', dry, no sample collected.
-430			CONGLOMERATE: Sandy, silty, partially indurated, cobbles to 60 mm, subangular to angular, sandy matrix is moderately sorted, clasts of various lithologies.	Core #7, 424-430', 100% rec. Core #8, 430-436', 100% rec.
-440				Core #9, 436-442.5', 100% rec.
-450			SM: SAND - silty, very fine grained quartz, brown (7.5 YR 5/4), well sorted, well consolidated, stiff.	Core #10, 442.5-453', 86% rec. MW = 8.6, Vis = 58. Core #11, 453-465', 100% rec.
-460			CONGLOMERATE: Large well rounded cobbles to 3.1-inches, well indurated to loosely consolidated.	Coring at 456' at 0000 hr on 04/12.
-470				Core #12, 465-474', 94% rec.
-480				Core #13, 474-477', 100% rec. Core #14, 477-485', 100% rec.
-490				Core #15, 485-490', 100% rec. Core #16, 490-495', 60% rec. Century Geophysical ran e-logs at 495' on 04/12.
-500			ML: SILT AND CLAY - brown, incompetent, slightly moist, with fine to very fine grained quartz sand, as above.	Core #17, 495-505', 100% rec.
-510				Core #18, 505-521', 100% rec.

BOREHOLE No.: TH02

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-520			CONGLOMERATE: Rounded cobbles to 3.9-inches, some calcite filled vugs; interbedded with layers of silt, brown, and sand, coarse grained.	
				Core #19, 521-527', 100% rec.
-530				Core #20, 527-545', 100% rec.
-540				
				Coring at 545' at 0000 hr on 04/14.
-550				Core #21, 545-554', 100% rec.
-560				Core #22, 554-563', 100% rec.
				Core #23, 563-583', 100% rec.
-570				Ream hole to 8 3/4" from 0' to 583'. Set 6 5/8" steel casing at 583' on 04/15.
-580				Switch to wire line coring method at 586' on 04/22. Hole size 4.25", core size 2.25". Core #24, 586-588', 100% rec.
-590				Coring at 586' at 0000 hr on 04/22.
				Core #25, 588-590', 25% rec.
-600				Core #26, 590-592', 50% rec.
				Core #27, 592-597', 40% rec.
-610				Core #28, 597-607', 50% rec.
				Core #29, 607-612', 40% rec.
-620				Core #30, 612-617', 80% rec.
				Core #31, 617-622', 20% rec.
-630			CONGLOMERATE: As above, spar noted in vugs.	Core #32, 622-623', 100% rec. Core #33, 623-628', 70% rec. Core #34, 628-633', 50% rec. MW = 8.7, vis = 42.
-640			CONGLOMERATE: As above. Rounded cobbles, some calcite filled vugs; interbedded with layers of silt, brown, and sand, coarse grained.	Core #35, 633-638', 70% rec. Core #36, 638-643', 10% rec.
				Core #37, 643-645', 25% rec.
-650				Core #38, 645-649', 50% rec.
				Core #39, 649-653', 50% rec.
-660				Core #40, 653-657', 25% rec. Core #41, 657-663', 58% rec.
				Coring at 663' at 0000 hr on 04/23.
-670				Core #42, 663-667', 38% rec.
				Core #43, 667-674', 0% rec.
-680				Core #44, 674-679', 0% rec. Core #45, 679-681', 100% rec. Core #46, 681-684.5', 57% rec.
			GRAVEL AND SAND: Loose, poorly sorted, sandy with some clay.	Core #47, 684.5-686.5', 38% rec. Core #48, 686.5-689', 92% rec.
-690				Collected zone #5 formation water samples from 688-708' on 05/07.
			CONGLOMERATE: Well indurated, 1.2 - 2.4-inch cobbles, predominantly limestone, interlayered with 2 - 3-inch poorly sorted, loose gravelly sand and clay	Core #49, 689-694', 60% rec. Core #50, 694-697', 100% rec. Core #51, 697-699', 75% rec.

BOREHOLE No.: TH02



LITHOLOGY DESCRIPTION	REMARKS
lenses. Cored through 20 - 24 inch diameter clastic igneous boulder 699 to 701 feet.	Core #52, 699-703', 75% rec. Core #53, 703-708', 80% rec. Core #54, 708-713', 100% rec. Coring at 708' at 0000 hr on 04/24. Collected zone #4 formation water samples from 712-732' on 05/07. Core #55, 713-715', 50% rec. Core #56, 715-716.5', 67% rec. Core #57, 716.5-723', 0% rec.
CONGLOMERATE: As above with 4-inch section of microcrystralline limestone at bottom of samples.	Core #58, 723-725', 0% rec. Core #59, 725-727', 0% rec. Core #60, 727-733', 25% rec.
CONGLOMERATE: As above, Limestone cobbles, subangular to subrounded, 1 - 1.5-inch clay layers.	Core #61, 733-738', 20% rec. Core #62, 738-743', 50% rec.
GRAVEL AND SAND: Loose, poorly sorted, sandy, clayey gravels with 40 - 70 mm subrounded cobbles.	Core #63, 743-748', 0% rec. Core #64, 748-749.5', 67% rec. Core #65, 749.5-751', 0% rec. Reamed hole from 4.25" to 6.25" from 583 to 751'. Switch to 4" ID core at 752' on 04/25.
CONGLOMERATE: As above, LS cobbles, subrounded to rounded; 1/2 core well consolidated, med. gray to med. brown; 1/2 broken, loose LS fragments and rubble, angular to subangular, calcareous, dark gray.	Coring at 760' at 0000 hr on 04/26. Core #66, 752-760', 38% rec. MW = 8.9, vis = 59.
SILTSTONE: Medium brown, hard, no cobbles.	Core #67, 760-764', 63% rec. Core #68, 764-774', 90% rec. Core #69, 774-779', 100% rec.
CONGLOMERATE: As above.	Core #70, 779-785', 100% rec.
GRAVEL AND SAND: Loose, poorly sorted, sandy, coarse grained matrix, silty, clayey gravels; cobbles, subangular to angular, limestone.	Core #71, 785-792', 86% rec.
CONGLOMERATE: Limestone with silty clay matrix, 1/3 consolidated, medium brown to medium gray, trace vugs in upper 6-inches; 2/3 loosely consolidated rubble, cobbles angular to subagnular.	Core #72, 792-794', 75% rec. Core #73, 794-799', 50% rec. Coring at 799' at 0000 hr om 04/27. Core #74, 799-804', 95% rec. Core #75, 804-811', 57% rec. Core #76, 811-816', 50% rec.
GRAVEL AND SAND: As above, loose, poorly sorted, 40% sand; cobbles are subangular limestone.	Core #77, 816-821', 80% rec. Core #78, 821-830', 56% rec. Core #79, 830-836', 50% rec.
CONGLOMERATE: As above.	Core #80, 836-842', 50% rec. Coring at 842' at 0000 hr on 04/28.
SILTSTONE: Top of Bedrock - Angular unconformity noted between basin fill and bedrock.	Core #81, 842-850', 100% rec. Top Pennsylvanian bedrock at 845'.
SILTSTONE: Stiff, scratches with knife, slightly calcareous, medium brown.	Core #82, 850-859', 100% rec.
LIMESTONE MUDSTONE: Alternating sequence of limestone and siltstone; limestone, gray to dark gray, bedded with abundant calcite filling fractures 100%, white, fractures 1/8 to 1/4-inch wide, siltstone, brownish yellow (10 YR 6/8).	Core #83, 859-866', 71% rec. Core #84, 866-877', 100% rec. Collected zone #3 formation water samples from 860-880' on 05/06.
LIMESTONE AND SHALE INTERBEDS: Gray to gray brown, bedding planes, abundant calcite filled	Core #85, 877-886.5', 121% rec. Coring at 880' at 0000 hr on 04/29.

BOREHOLE No.: TH02

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-890			fractures, clay layers, reddish brown, plastic.	MT = 79.9 F at 886'.
			SILTSTONE: Light olive brown (2.5 Y 5/3), high angle bedding, competent, calcite and spar filled fractures.	Core #86, 886.5-892', 100% rec.
-900			SILTSTONE: As above, broken fragments, calcareous, stiff.	Core #87, 892-901', 100% rec. Core #88, 901-915', 100% rec. Core #89, 915-932.5', 100% rec. Coring at 926' at 0000 hr on 04/30.
-910			LIMESTONE: As above, gray to grayish brown: white calcite filled fractures, minor vugs, calcite filled.	Core #90, 932.5-938', 100% rec. Core #91, 938-952', 100% rec. Collected zone #2 formation water samples from 924-944' on 05/06.
-920				Set tubing at 840' and developed well by air lifting on 05/08-09.
-930			SILTSTONE: Medium brown, stiff, 80% solid.	Collected zone #1 formation water samples from 944-964' on 05/06.
-940			LIMESTONE AND SHALE INTERBEDS: As above, 50% limestone as above and 50% claystone, as above.	Century Geophysical ran e-logs on 05/05 from total depth (TD) into casing (583').
-950				Core #92, 952-963', 100% rec. Coring at 963' at 0000 hr on 05/01. Core #93, 963-972', 100% rec. Lose circulation briefly at 958'.
-960				Set 421' of 4" ID 8 x 3" slotted screen from 586' to 972' on 05/08 with K packer at top screen inside 6 5/8" casing.
-970			LIMESTONE: As above, 10% shale near bottom of core.	TD = 972' at 0620 hr on 05/01.
			TOTAL DEPTH = 972 feet bgs.	

EPWU Test Hole 3

TETRA TECH NUS, INC.
Houston, Texas

RECORD OF WELL CONSTRUCTION
TEST/PILOT HOLE INVESTIGATION
FORT BLISS, EL PASO COUNTY, TEXAS

WELL NO.: TH03
DRILLER: Stewart Brothers Drilling Co.
DRILLING METHOD: Failing CF-2500 Mud Rotary
DEVELOPMENT METHOD: Swab

CLIENT: Corps of Engineers
PROJECT NUMBER: N7551.327D
DATES INSTALLED: 05/10/03-07/28/03
FIELD GEOLOGISTS: Basilio, Jorgeson, Gaylor, Cochran

WELL DATA

BORE HOLE
DIAMETER: 8 3/4 IN. FROM 0 TO 39 FT.
6 1/4 IN. FROM 39 TO 1095 FT.
5 1/8 IN. FROM 1095 TO 2894 FT.

CASING
TYPE: STEEL
DIAMETER: 6 5/8 IN. LENGTH: 39 FT.
INTERVAL: FROM 0 TO 39 FT.
DIAMETER: 5 9/16 IN. LENGTH: 1056 FT.
INTERVAL: FROM 39 TO 1095 FT.

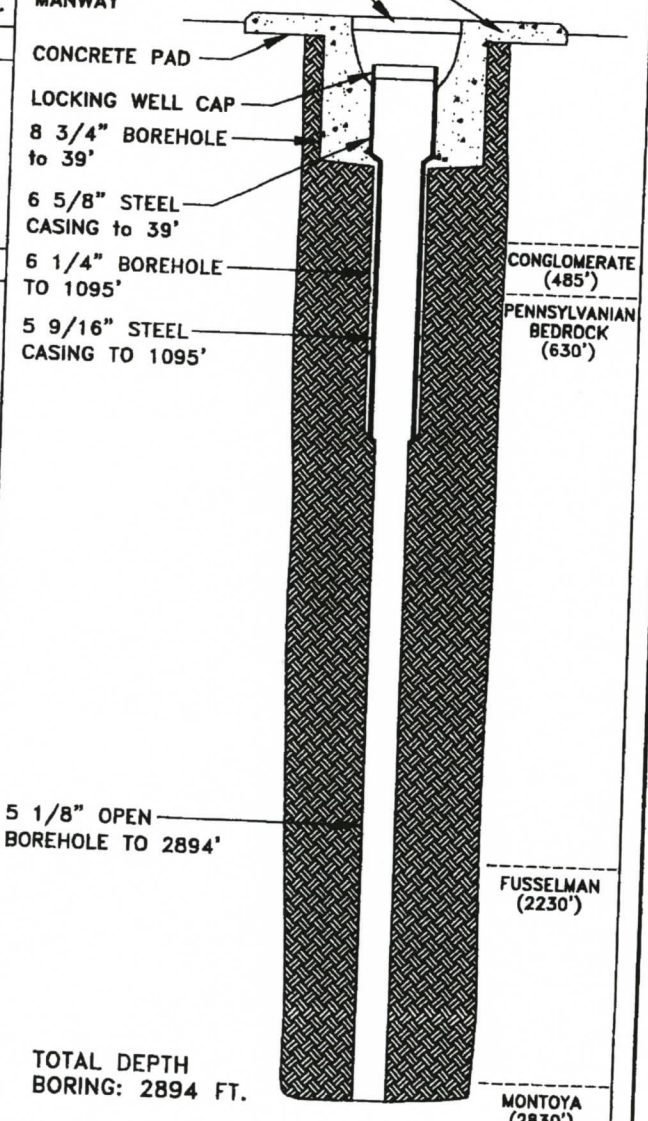
SCREEN
TYPE: NO WELL SCREEN - OPEN HOLE COMPLETION
SLOT: NOT APPLICABLE
DIAMETER: 5 1/8 IN. LENGTH: 1838 FT.
INTERVAL: FROM 1095 TO 2894 FT.

SURFACE COMPLETION
TYPE: 4'X4'X6" REINFORCED CONCRETE PAD WITH BOLTDOWN COVER

GROUT
TYPE: PORTLAND CEMENT WITH 1% BENTONITE AND 3% CALCIUM CHLORIDE
QUANTITY: 10 SACKS
INTERVAL: FROM 0 TO 39 FT.
TYPE: PORTLAND CEMENT
QUANTITY: 114 SACKS
INTERVAL: FROM 39 TO 1095 FT.

COMMENTS

NORTHING: 893,991.81
EASTING: 211,022.58
GROUND SURFACE ELEVATION: 4,132.5



TOTAL DEPTH BORING: 2894 FT.

Not to Scale

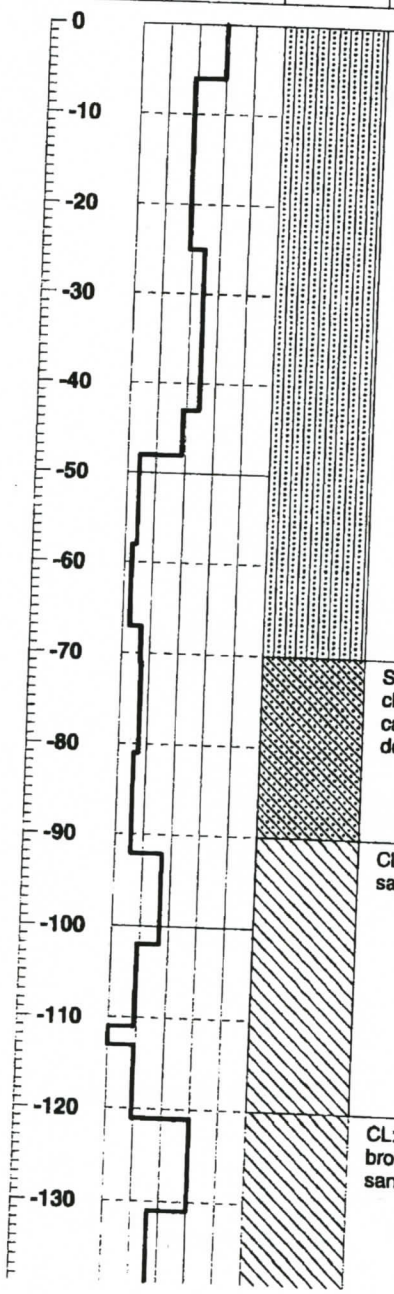
TETRA TECH NUS, INC.
Houston, Texas

BOREHOLE No.: TH03

NORTHING: 893,991.81
EASTING: 211,022.58
ELEVATION: 4151.5 Feet

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Test/Pilot Hole Investigation**	DRILLING CO.:	**Stewart Brothers Drilling**
SITE LOCATION:	**Fort Bliss, El Paso County, TX**	DRILLER:	**S. Odom/J. Brunson**
JOB NO.:	**N7551 327D**	RIG TYPE:	**Failing CF-2500**
LOGGED BY:	**Tetra Tech NUS, Inc.**	METHOD OF DRILLING:	**Mud Rotary**
PROJECT MANAGER:	**Mike Meenan**	SAMPLING METHODS:	**Drill Cuttings/Cores**
DATES DRILLED:	**5/10/03 - 7/28/03**	TOTAL DEPTH:	**2894 feet bgs**

NOTES: All color references are to the Munsell Color Chart.



LITHOLOGY DESCRIPTION	REMARKS
SM: SAND - medium to light brown, very fine grained, silty, subangular to subrounded, fair sorting, trace dark minerals, trace 5-10mm gravel, caliche up to 10%. Increase in percentage of gravel and caliche with depth.	Begin drilling 0145 hr on 05/10. Hole Size: 6 1/4" using Drag bit. Ream hole to 8 1/4" ton 40' and set 6 5/8" steel casing from surface to 39' on 5/25. Deviation = 0.0 deg at 48'.
SC: SAND - medium to light brown, very fine grained, clayey, subangular to subrounded, moderate sorting, caliche nodules present. Increasing clay content with depth.	
CL: CLAY - light brown (5 YR 6/4), plastic, soft, very sandy, sand is very fine grained.	Lose circulation (LC) intermittantly at 102' on 05/10. Add Lost Circulation Material (LCM). Drilling at 158 ft at 0000 hr on 05/11.
CL: CLAY - light brown (5 YR 6/4) to dark yellowish brown (10 YR 4/2), very plastic, moderately soft, sandy, sand is very fine grained, trace of caliche.	Mud Temperature (MT) = 72.5 F at 135'. (All temperatures measured in degrees Fahrenheit at the mud discharge point from the open hole diverter pipe or, if cased, from the top of the casing.)

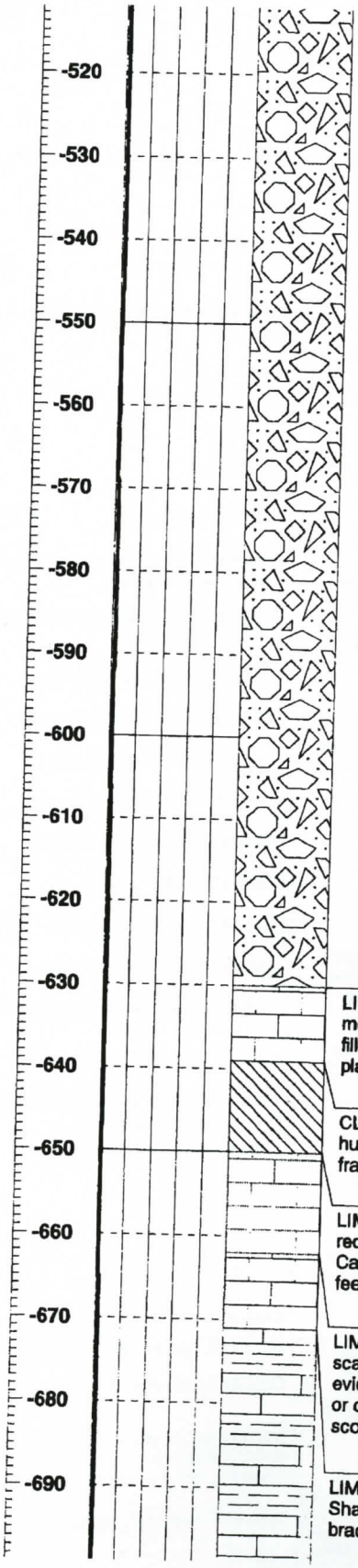
BOREHOLE No.: TH03

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-140				
-150				
-160				
-170				
-180				
-190			CL: CLAY - as above, increase (15-20%) of coarse grained gravel to 10 mm, gravel is rounded to subrounded, decrease to 10% with depth, clay and sand is slightly calcareous.	
-200				
-210				
-220				
-230				
-240				
-250				
-260				
-270			CL: CLAY - medium brown, soft, silty and sandy, trace gravel, increase in sand and gravel content with depth.	
-280				
-290				
-300				Deviation = <0.25 deg at 300'.
-310			CL: CLAY - medium brown, very silty and sandy, sand is very fine grained, increase in gravel to 15%, sand and gravel percentage varies with depth, trace of dark minerals, 5% 2-5mm limestone fragments at 330 ft.	
-320				MT = 87.3 F at 316'.

BOREHOLE No.: TH03

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-330				
-340				
-350				
-360				Deviation = 0.25 deg at 360'.
-370				
-380				
-390				MT = 88.2 F at 390'.
-400			CL: CLAY - medium brown (10 YR 6/2-5/4), pale yellowish brown to medium yellowish brown, stiff, dry, broken into 6-12-inch sections, slightly calcareous.	Switch to conventional coring, 6" hole dia., 4"core dia. Coring at 395 ft at 0000 hr on 05/12, no recovery (rec).
-410				Core #1, 404-409', 35% rec.
-420			CL: CLAY - brown (7.5 YR 5/4) to medium brownish yellow (10 YR 5/4), very stiff to hard, silty, dry to damp, fair to well indurated, grades to claystone in parts.	Core #2, 409-414', 107% rec. Core #3, 414-419', 0% rec. Core #4, 419-424', 140% rec.
-430				Core #5, 424-429', 180% rec. Core #6, 429-434', 40% rec.
-440			SILTSTONE: clayey silt as above, interbedded with conglomerate. Conglomerate is medium gray to light brown, subrounded to subangular, gravel and cobbles to 3-inch, 50% is stiff and well consolidated, 50% is loose.	Core #7, 434-439', 0% rec. Core #8, 439-444', 240% rec. Coring at 444 ft at 0000 hr on 05/13.
-450				Core #9, 444-461', 112% rec.
-460				Water sample interval 450 to 470', dry, no sample collected. Core #10, 461-481', 105% rec.
-470				
-480				Core #11, 481-484.5', 46% rec.
-490			CONGLOMERATE: subangular to subrounded, some angular, compsed of limestone and ingneous rock, loose to well cemented in a silty matrix, limestone is brownish gray (10 YR 5/2) to very dark grayish brown (10 YR 3/2), some lighter fragments, sucrosic, moderate HCL reaction, some calcite filled fractures present in fragments, trace black chert.	Core #12, 484.5-489', 133% rec. Core #13, 489-499', 100% rec.
-500				Conduct geophysical logging from 0 to 499' on 05/13. Coring at 499 ft at 0000 hr on 05/14.
-510			CONGLOMERATE: As above, interbedded siltstone and	Core #14, 499-518', 100% rec.

BOREHOLE No.: TH03



DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
			conglomerate.	Water sample interval 500 to 520', dry, no sample collected.
				Core #15, 518-528', 60% rec.
				Core #16, 528-532', 200% rec.
				Core #17, 532-536.5', 89% rec.
				Core #18, 536.5-544', 93% rec.
				Core #19, 544-546.5', 80% rec.
				Coring at 546 ft at 0000 hr on 05/15.
				Core #20, 546.5-550.5', 100% rec.
				Core #21, 550.5-557.5', 86% rec.
				Core #22, 557.5-561', 86% rec.
				Core #23, 561-566', 90% rec.
				Core #24, 566-574.5', 88% rec.
				Coring at 569 ft at 0000 hr on 05/20.
				Core #25, 574.5-580.5', 100% rec.
				Core #26, 580.5-585.5', 80% rec.
				Core #27, 585.5-593.5', 100% rec.
				MW = 8.8, viscosity (vis) = 67.
				Core #28, 593.5-598', 100% rec.
				Core #29, 598-605', 100% rec.
				Coring at 606 ft at 0000 hr on 05/21.
				Core #30, 605-608', 92% rec.
				Core #31, 608-611', 92% rec.
				Core #32, 611-628', 100% rec.
				MW = 8.7, vis = 51.
630			LIMESTONE: dark gray (10 YR 4/1), dense, sucrosic, moderate HCL reaction, scattered hairline to 3mm calcite filled fractures. Silt and clay filled fractures/bedding planes at <30 degree angle.	Top Pennsylvanian bedrock at 630'.
				Core #33, 629-641', 100% rec.
640			CL: CLAY - brownish yellow (10 YR 6/8), with varied hues, silty, moderately stiff, plastic, contains limestone fragments. Transition from clay to limestone at 650 feet.	Core #34, 641-647', 50% rec.
650				Coring at 647 ft at 0000 hr on 05/22.
				Core #35, 647-652', 100% rec.
				Core #36, 652-660', 86% rec.
660			LIMESTONE: blueish gray, very dense, competent, reddish brown along fractures (possible iron stains). Calcareous dark gray shale parting from 660 feet to 662 feet.	Core #37, 660-678', 106% rec.
670				Water sample interval 655 to 675', dry, no sample collected.
680			LIMESTONE: dark gray black, sucrosic to micritic, scattered clay partings, finely desseminated pyrite, evidence of fractures but they are closed with calcite or clay, brachiopods and some fusulinids present, scour structure at 668 ft.	Core #38, 678-697', 105% rec.
690			LIMESTONE AND SHALE INTERBEDS: Limestone and Shale interbedded, black, scour structures present, brachiopods, crinoids, rugose corals present.	Water sample interval 690 to 610', dry, no sample collected.

BOREHOLE No.: TH03

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-700				Coring at 697 ft at 0000 hr on 05/23.
-710				Core #39, 697-710', 100% rec.
			SHALE: dark gray (2.5 Y N4), becoming more fissile with depth, breaks into laminations, carbonaceous, fossiliferous (brachiopods), trace disseminated pyrite, interbedded with light gray shaley limestone. Noticible banding of light and dark colors at 757 ft. Increase in limestone content with depth.	Core #40, 710-717', 100% rec.
-720				Core #41, 717-733', 106% rec.
-730				
-740				Core #42, 733-751', 100% rec.
				Coring at 741 ft at 0000 hr on 05/24.
-750				Core #43, 751-764', 77% rec.
-760				Drilled to TD of 764' on 05/24.
			LIMESTONE: dark gray (5 YR 4/0 - 5/0), 75% hard crystalline faces, trace calcite crystals on some framents. Multi-colored pebbles present (may be cavings).	Conduct geophysical logging from 759 to 0' on 05/24.
-770				Re-entered hole on 07/07 to deepen from 764' to test for the depth of the Fusselman Formation. Hole Size: 6 1/4" using tricone drill bit.
-780				
-790				
			LIMESTONE AND SHALE INTERBEDS: transition between light gray limestone and dark gray calcareous shale, subrounded fragments, traces of pyrite.	
-800				
-810				
			SHALE: dark gray calcareous shale, subangular to subrounded fragments. Color darkens with depth.	
-820				
-830				
-840				
-850				
-860				Drilling at 852' at 0000 hr on 06/08.
				Deviation = 0.5 deg at 858'.
-870				
-880				

BOREHOLE No.: TH03

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-890				
-900			SHALE WITH LIMESTONE INTERBEDS: as above, lighter colored, light gray limestone fragments present.	Deviation = 0.5 deg at 898'. Hole Size: 6 1/8" at 898' using tricone drill bit.
-910				
-920				
-930				Drilling at 932' at 0000 hr on 06/09.
-940				
-950				
-960				Deviation = 1.0 deg at 956'.
-970				
-980				
-990				
-1000				Deviation = 0.5 deg at 994'.
-1010				
-1020				Drilling at 1012' at 0000 hr on 06/10.
-1030				
-1040				
-1050				
-1060				Deviation = 0.5 deg at 1059'.
-1070				

BOREHOLE No.: TH03

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-1080			LIMESTONE: medium gray (7.5 YR 6/0), hard, broken into 2 to 6-inch segments, trace calcite on broken surfaces, trace vugs at 1085 ft but generally without visible porosity.	Lose circulation. Drill blind (without mud returns) to 1081'. Switch to coring. Hole size: 6". Collect 4" conventional cores.
-1090			LIMESTONE: Drill blind, no returns.	Coring at 1082' at 0000 hr on 06/11. Core #44, 1082-1086.5', 100% rec.
-1100				At 1087' at 0000 hr on 06/12.
-1110				Fight LC. Set 5 cement plugs. Unable to establish returns. Resume drilling ahead blind to 1145'.
-1120				Set 5.56" OD x 5.18" ID casing at 1095' on 06/20.
-1130				Drilling at 1111' at 0000 hr on 06/19.
-1140			LIMESTONE: dark gray (10 YR 4/1), crystalline, trace subrounded quartz grains, reactive with HCL.	At 1145' at 0000 hr on 06/20-21.
-1150				Drilling at 1146' at 0000 hr on 06/22.
-1160				
-1170				Lose circulation from 1170 to 1196'. Cement LCZ multiple times. Regain circulation on 06/23.
-1180				
-1190			LIMESTONE: dark gray to very dark gray (10 YR 3/1), sucrosic texture, reactive to HCL, some conchoidal fractures, trace yellow to pink chert.	At 1196' at 0000 hr on 06/23.
-1200				
-1210				Drilling at 1205' at 0000 hr on 06/24.
-1220				
-1230			LIMESTONE: very dark gray (10 YR 4/1), micritic texture, some conchoidal fractures, some dark grayish brown (10 YR 4/2) limestone, platy and angular, reacts with HCL, trace black limey shale, trace reddish brown chert towards base.	
-1240				Lose circulation at 1239'. Regain after adding lost circulation materials (LCM).
-1250				

BOREHOLE No.: TH03

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-1260				
-1270				
-1280				
-1290			MAFIC INTRUSIVE: light gray (10 YR 7/1), subangular to subrounded clasts, sucrosic texture, does not react in HCL.	Drilling at 1286' at 0000 hr on 06/25.
-1300				
-1310				Switch from rotary drilling to coring at 1313'. Hole size: 5", collect 3" diameter core.
-1320			MAFIC INTRUSIVE: white (10 YR 8/1) to light gray (10 YR 7/1), phenocrysts present, altered to calcite, trace soft flakey green inclusions.	Core #45, 1313-1317', 100% rec. Core #46, 1317-1327', 100% rec.
-1330			LIMESTONE: dark gray (10 YR 4/1), some lighter gray sections, trace vugs, interbedded with shale.	Coring at 1325' at 0000 hr on 06/26. Core #47, 1327-1346', 95% rec.
-1340				
-1350			LIMESTONE: very dark gray (10 YR 3/1) to dark grayish brown (10 YR 4/2), brownish greensh hue present in parts, micritic, dense, high angle fractures present, some are open, some are filled with calcite, scattered marcasite, trace styolites, some clay filling in fractures, scour structure at 1398 ft.	Core #48, 1346-1366', 100% rec.
-1360				
-1370				Core #49, 1366-1380', 100% rec.
-1380				Core #50, 1380-1394', 70% rec.
-1390				Coring at 1382' at 0000 hr on 06/27.
-1400				Core #51, 1394-1414', 100% rec.
-1410				Core #52, 1414-1415', 100% rec.
-1420				Switch from coring to rotary drilling. Hole size: 5 1/8-inch.
-1430			LIMESTONE: dark gray (10 YR 4/1), color darkens and lightens throughout section, crystalline, flakey, subangular clasts.	Drilling at 1423' at 0000 hr on 06/28.
-1440				

BOREHOLE No.: TH03

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-1450				
-1460				
-1470				
-1480				Deviation = 0.5 deg at 1480'.
-1490				Lose circulation briefly at 1487'.
-1500				Drilling at 1502' at 0000 hr on 06/29.
-1510				
-1520				
-1530				
-1540				
-1550				
-1560			LIMESTONE: as above, more shaley.	Deviation = 0.5 deg at 1561'.
-1570				
-1580				
-1590				
-1600				
-1610				
-1620				
-1630				Lose circulation at 1624'. Regain circulation at 1633'.

BOREHOLE No.: TH03

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-1640				Drilling at 1633' at 0000 hr on 07/08.
-1650				
-1660				
-1670				
-1680				
-1690				Drilling at 1681' at 0000 hr on 07/09.
-1700				
-1710			LIMESTONE: as above, increase in white (7.5 YR 8/0) clasts to 50%, angular, imbedded dark minerals.	
-1720				
-1730				
-1740			LIMESTONE: dark gray (7.5 YR 4/0), flakey, subangular, reacts with HCL, trace very dark gray black shale.	
-1750				
-1760				
-1770				MW = 8.5, vis = 68.
-1780				
-1790				
-1800				
-1810				Drilling at 1804' at 0000 hr on 07/10.

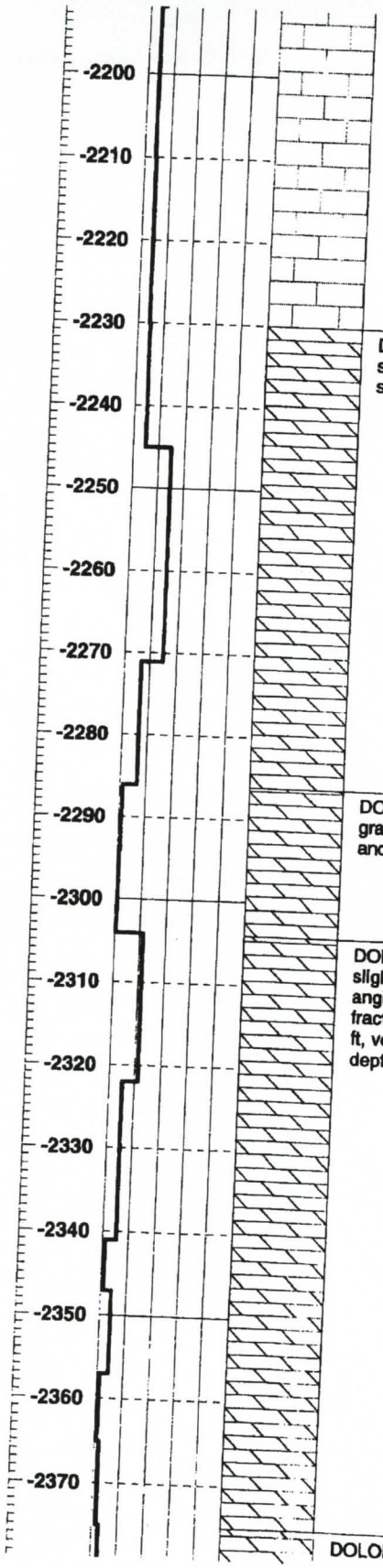
BOREHOLE No.: TH03

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-1820				
-1830				
-1840				
-1850				
-1860			LIMESTONE: as above, color lightens and darkens with depth, increased shale content, very shaley at base.	
-1870				
-1880				
-1890				Lose circulation intermittantly from 1880 to 1890'.
-1900				
-1910				Drilling at 1907' at 0000 hr on 7/11.
-1920				Deviation = 0.5 deg at 1907'.
-1930				Lose circulation intermittantly from 1907 to 1926'.
-1940				
-1950				
-1960				
-1970				
-1980				
-1990				Lose circulation intermittantly from 1990 to 2000'.
-2000				Drilling at 1992' at 0000 hr on 07/12.

BOREHOLE No.: TH03

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-2010				
-2020				
-2030				
-2040				
-2050			SHALE: black (7.5 YR 2/0), subangular, platey to flakey, elongated, slightly pitted and striated surface texture, moderately hard, none to very slight reaction with HCL, trace mica, trace pyrite.	
-2060				
-2070				
-2080				
-2090				
-2100				
-2110			SHALE: as above, increased limestone content with depth.	
-2120				
-2130				
-2140				
-2150				
-2160			LIMESTONE: very dark gray (7.5 YR 3/0), subangular, blocky to platey, slightly elongated, slight to moderate HCL reaction, very shaley.	
-2170				
-2180				
-2190				

BOREHOLE No.: TH03



DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
				Drilling at 2192' at 0000 hr on 07/13.
			DOLOMITE: dark gray (7.5 YR 4/6) to gray (7.5 YR 6/0), subangular, platey slight to moderate HCL reaction, slight red stain with Alizarin, intebedded with limestone.	Top Silurian Fusselman Dolomite Formation.
			DOLOMITE: light to dark gray, fine to medium to sucrosic grained, vuggy, fractured, fractures filled with calcite and dolomite, brecciated, secondary porosity present.	Switch to coring. Hole size: 5", collect 3" cores. Coring at 2286' at 0000 hr on 07/14. Core #53, 2286-2294', 100% rec. Core #54, 2294-2304', 80% rec. Lose circulation at 2300'. Coring at 2303' at 0000 hr on 07/15.
			DOLOMITE: medium to dark gray, dense, fine grained to slightly sucrosic, broken and fractured in parts, high angle planes present, trace pyrite, calcite healed fractures present, slightly vuggy from 2304 ft to 2318 ft, very vuggy from 2343 ft to 2346 ft, less vuggy with depth.	Core #55, 2304-2322', 100% rec. Core #56, 2322-2341', 100% rec. Coring at 2341' at 0000 hr on 07/16. Core #57, 2341-2347', 100% rec. Core #58, 2347-2357', 100% rec. Coring at 2357' at 0000 hr on 07/17. Core #59, 2357-2364', 10% rec. At 2365' at 0000 hr on 07/22. Core #60, 2364-2375', 45% rec.
			DOLOMITE: Drill blind, no returns.	At 2375' at 0000 hr on 07/23.

BOREHOLE No.: TH03

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-2380				Switch to rotary drilling. Hole size - 5 1/8".
-2390				
-2400				
-2410				
-2420				
-2430				
-2440				
-2450				
-2460				
-2470				At 2474' at 0000 hr on 07/24.
-2480			DOLOMITE: gray, hard, blocky at top and bottom, broken in middle section, several high angle fractures, some vugs present, vugs are smaller than previous.	Switch to coring. Hole size 5", core size 3". Core #61, 2475-2482', 100% rec.
-2490			DOLOMITE: Drill blind, no returns.	Switch to rotary drilling. Hole size - 5 1/8".
-2500				
-2510				
-2520				
-2530				
-2540				
-2550				Drilling at 2551' at 0000 hr on 07/25.
-2560				

BOREHOLE No.: TH03

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-2570				
-2580			DOLOMITE: gray, hard, broken, high angle fractures spaced 6" apart, fractures are cemented, less vugs than before.	Switch to coring. Hole size 5", core size 3".
-2590			DOLOMITE: Drill blind, no returns.	Core #62, 2575'-2581', 100% rec. Switch to rotary drilling. Hole size - 5 1/8".
-2600				
-2610				
-2620				
-2630				
-2640				
-2650				
-2660				
-2670				Drilling at 2665' at 0000 hr on 07/26.
-2680			DOLOMITE: gray, hard, crystalline, blocky at top, transitions to very broken at bottom, few high angle fractures, no vugs, no cemented fractures, sample is more calcitic.	Switch to coring. Hole size 5", core size 3". Core #63, 2675-2583', 100% rec. Switch to rotary drilling. Hole size - 5 1/8".
-2690			DOLOMITE: Drill blind, no returns.	
-2700				
-2710				
-2720				
-2730				
-2740				Drilling at 2740' at 0000 hr on 07/27.
-2750				

BOREHOLE No.: TH03

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-2760				
-2770				Switch to coring. Hole size 5", core size 3".
-2780			DOLOMITE: gray, less uniform in color, crystalline, hard, broken, a few (trace) high angle fractures.	Core #64, 2775-2778.5', 71% rec.
			DOLOMITE: Drill blind, no returns.	Switch to rotary drilling. Hole size - 5 1/8".
-2790				
-2800				
-2810				Drilling at 2809' at 0000 hr on 07/28.
-2820				
-2830				Top Montoya at 2830 (based on geophysical logs due to no mud circulation and therefore no drill cuttings).
-2840				Collected formation water sample from 2830-2850 on '.
-2850				
-2860				
-2870				
-2880				Switch to coring. Hole size 5", core size 3". Core #65, 2890-2894', 38% rec.
-2890			DOLOMITE: cherty, gray, hard, broken, chert is light gray to white, subangular, sized from 2mm - 10mm.	TD = 2894' at 2110 hr on 07/28.
			TOTAL DEPTH = 2894 feet bgs.	

EPWU Test Hole 4

TETRA TECH NUS, INC.
Houston, Texas

RECORD OF WELL CONSTRUCTION
TEST/PILOT HOLE INVESTIGATION
FORT BLISS, EL PASO COUNTY, TEXAS

WELL NO.: **TH04**
DRILLER: Stewart Brothers Drilling Co.
DRILLING METHOD: Failing CF-2500 Mud Rotary
DEVELOPMENT METHOD: Not Applicable

CLIENT: Corps of Engineers
PROJECT NUMBER: N7551.327D
DATES INSTALLED: 05/26/03-06/06/03
FIELD GEOLOGISTS: Basilio, Jorgeson, Sosa

WELL DATA

BORE HOLE
DIAMETER: 8 3/4 IN. FROM 0 TO 480 FT.
6 1/4 IN. FROM 480 TO 575 FT.

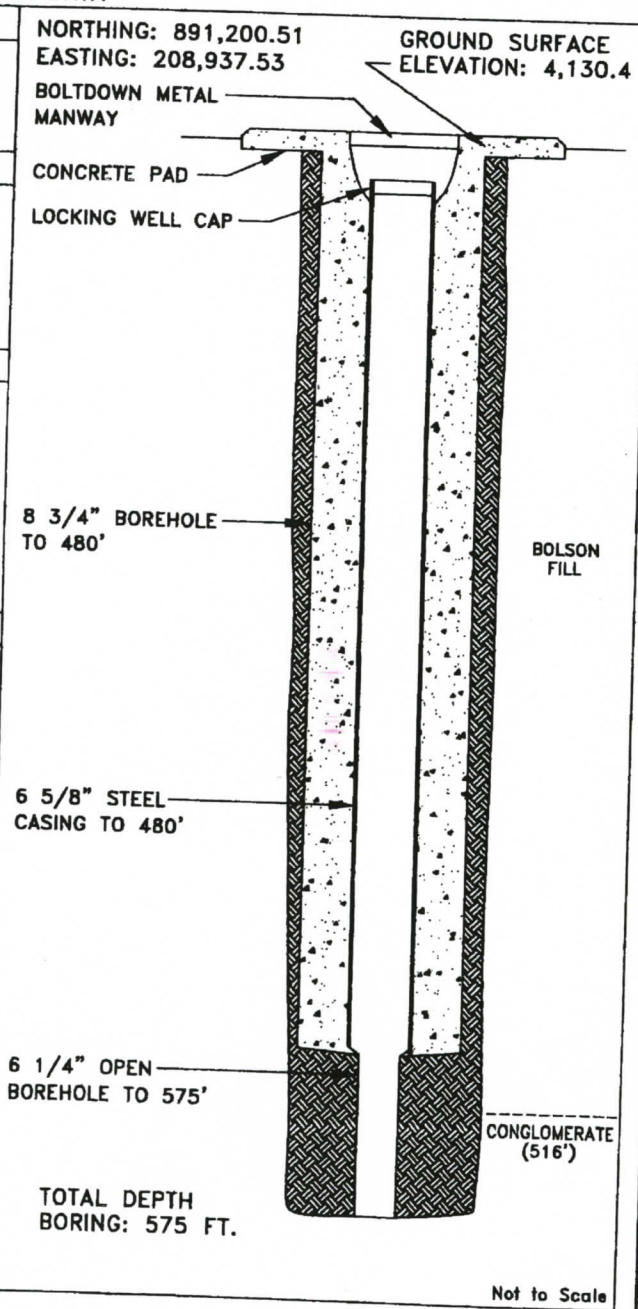
CASING
TYPE: STEEL
DIAMETER: 6 5/8 IN. LENGTH: 480 FT.
INTERVAL: FROM 0 TO 480 FT.

SCREEN
TYPE: NO WELL SCREEN, OPEN HOLE COMPLETION
SLOT: NOT APPLICABLE
DIAMETER: 6 1/4 IN. LENGTH: 95 FT.
INTERVAL: FROM 480 TO 575 FT.

SURFACE COMPLETION
TYPE: 4'X4'X6" REINFORCED CONCRETE PAD WITH BOLTDOWN COVER

GROUT
TYPE: PORTLAND CEMENT
QUANTITY: 95 SACKS
INTERVAL: FROM 0 TO 480 FT.

COMMENTS



TETRA TECH NUS, INC.
Houston, Texas

BOREHOLE No.: TH04

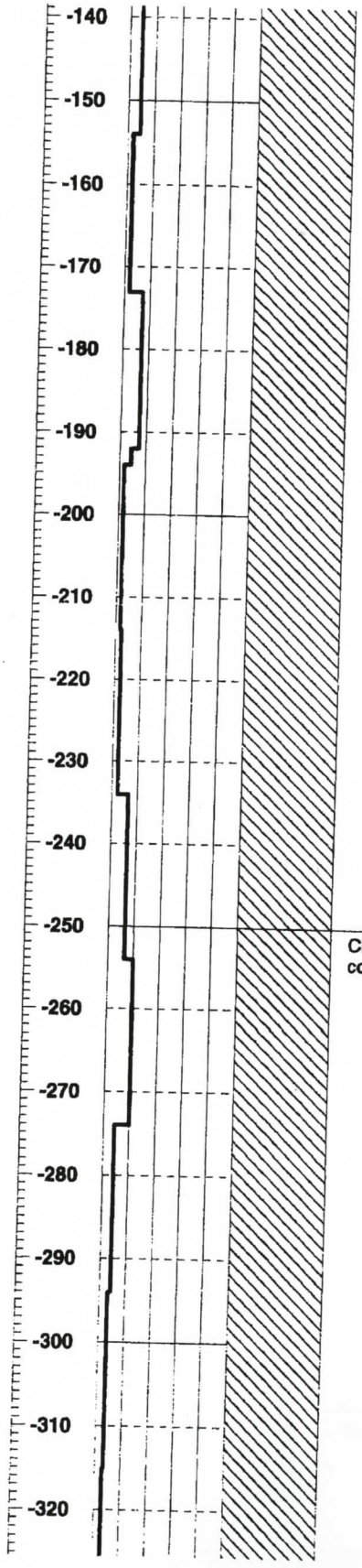
NORTHING: 891,200.51
EASTING: 208,937.53
ELEVATION: 4130.4 Feet MSL

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	Test/Pilot Hole Investigation	DRILLING CO.:	Stewart Brothers Drilling
SITE LOCATION:	Fort Bliss, El Paso County, TX	DRILLER:	S. Odom/J. Brunson
JOB NO.:	N7551 327D	RIG TYPE:	Failing CF-2500
LOGGED BY:	Tetra Tech NUS, Inc.	METHOD OF DRILLING:	Mud Rotary
PROJECT MANAGER:	Mike Meenan	SAMPLING METHODS:	Drill cuttings/Cores
DATES DRILLED:	5/26/03 - 6/6/03	TOTAL DEPTH:	575 feet bgs

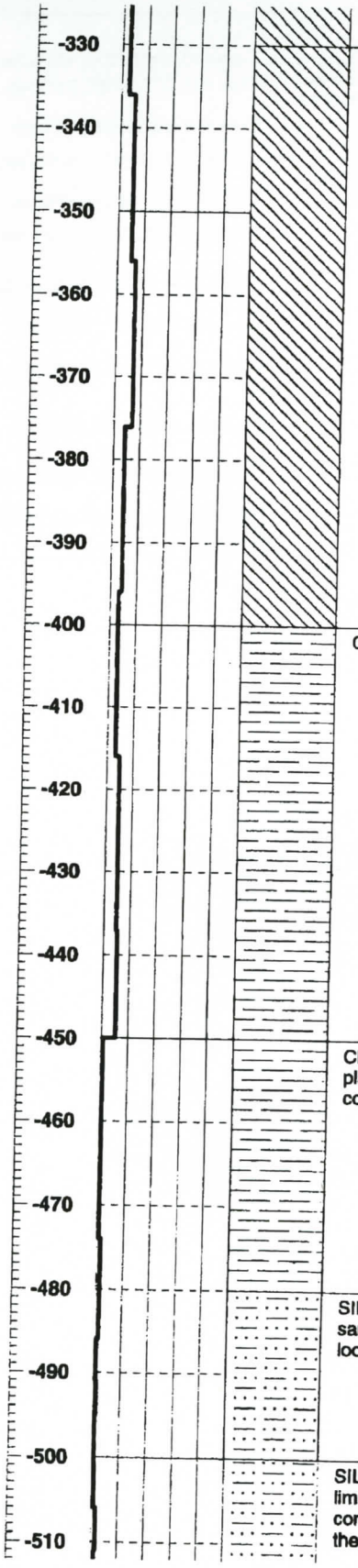
NOTES: All color references are to the Munsell Color Chart.

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
0			SM: SAND - dark brown (7.5 YR 4/4) to yellowish brown (10 YR 5/6), varied hues from light to dark brown throughout, very fine grained, subangular to subrounded, very clayey to silty, trace caliche, increase in caliche with depth, caliche is pinkish white and weathered.	Begin drilling 0930 hr on 5/26/03.
-10				Hole Size: 6 1/4-inch using Drag bit.
-20				
-30				
-40				
-50				
-60				
-70				Deviation = 0.25 deg at 67'.
-80				
-90				
-100			SC: SAND - medium to light brown, very fine grained, clayey, subangular to subrounded, increasing clay content with depth. Grades to clay.	Deviation = 0.25 deg at 96'.
-110				
-120			CL: CLAY - yellowish brown (10 YR 5/8) to light brown (5 YR 6/4), plastic, soft, very sandy, sand is very fine grained.	
-130				

BOREHOLE No.: TH04

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-140				
-150				
-160				
-170				
-180				
-190				Drilling at 192 ft at 0000 hr on 05/27.
-200				
-210				
-220				
-230				
-240				
-250			CL: CLAY - As above. Decrease in silt and sand content.	
-260				
-270				
-280				
-290				
-300				
-310				
-320				

BOREHOLE No.: TH04



DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-330				
			CL: CLAY - As above, increase in silt and sand content, trace dark minerals.	
-340				
-350				
-360				
-370				
-380				
-390				
-400				Water sample interval 400'-420', dry, no sample collected.
			CLAY & SILTY: As above, very silty.	
-410				
-420				Drilling at 416 ft at 0000 hr on 05/28.
-430				
-440				Switch to conventional coring, 6.0" hole dia., 4"core dia.
-450				Core #1, 450-456', 100% recovery (rec.).
			CLAY & SILTY: reddish yellow (7.5 YR 7/6), slightly plastic, slightly sandy, sand is very fine grained, loosely consolidated, moist.	
-460				Core #2, 456-474', 56% rec.
				Conduct geophysical logging, 0-480', on 5/28.
-470				Core #3, 474-480', 50% rec.
				At 480 ft at 0000 hr on 05/29.
-480				Ream open hole to 8 3/4" from 0-480' on 06/02. Set 6 5/8" casing from 0-480' on 06/03.
			SILTSTONE: brown, with clayey reddish yellow sand, sand is very fine grained, stiff, 70% consolidated, 30% loose.	
-490				Conventional coring, 6.0" hole dia., 4"core dia.
				Core #4, 481-486', 100% rec.
				Core #5, 486-491', 80% rec.
				Core #6, 491-496', 40% rec.
-500				Core #7, 496-501', 80% rec.
			SILTSTONE: As above with 1' thick limestone layers, limestone is brownish gray and competant. Grades to conglomerate at 516' with distinct gravel layers within the siltstone.	Core #8, 501-506', 0% rec.
				Coring at 504 ft at 0000 hr on 06/05.
-510				Core #9, 506-511', 240% rec.

BOREHOLE No.: TH04

DEPTH (feet)	DRILL RATE (feet/hour) 0 200	SYMBOL	LITHOLOGY DESCRIPTION	REMARKS
-520			CONGLOMERATE: very stiff, competant with cobbles ranging in size from 1" to 3", subangular to subrounded, 40% loose material.	Core #10, 511-517.5', 131% rec. Core #11, 517.5-522', 78% rec. Core #12, 522-526.5', 89% rec.
-530			CONGLOMERATE: As above with varying degrees of cementation and ranges of cobble size. Matrix is mostly siltstone with admixed sand and clay.	Core #13, 526.5-531', 100% rec. Core #14, 531-535.5', 67% rec. Core #15, 535.5-541', 109% rec. Coring at 541 ft at 0000 hr on 06/06. Core #16, 541-551', 100% rec. Core #17, 551-558', 100% rec. Core #18, 558-564.5', 92% rec. Core #19, 564.5-575', 109% rec. Total depth = 575' bgs at 1630 hr on 06/06.
-540				
-550				
-560				
-570				
			TOTAL DEPTH = 575 ft bgs.	

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer *Hueco Bolson* Field No. ______ State Well No. *49.15.301*

Owner's Well No. *#1* County *EP*

1. Location: ___ 1/4, ___ 1/4 Sec. ___, Block ___ Survey ______
(Paso View Land Development)
2. Owner: *G. McCardle (Desert Oasis Trailer Ct)* Address: *12705 Montana*
Tenant: ______ Address: ______
Driller: *Cole Drlg Co* Address: ______
3. Elevation of *LSD* is *4126* ft. above msl, determined by *7 1/2 TOPO*
4. Drilled: ___ *1* ___ 19 *76*; Dug, (Cable Tool), Rotary, ______
5. Depth: Rept. *558* ft. Meas. ______ ft.
6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed *Single pack*
7. Pump: Mfgr. ______ Type *Sub*
No. Stages ___, Bowls Diam. ___ in., Setting ___ ft.
Column Diam. ___ in., Length Tailpipe ___ ft.
8. Motor: Fuel *E/LC* Make & Model ______ HP. ___
9. Yield: Flow ___ gpm, Pump *86-100* gpm, Meas., Rept., Est. ______
10. Performance Test: Date ___ Length of Test ___ Made by ______
Static Level ___ ft. Pumping Level ___ ft. Drawdown ___ ft.
Production ___ gpm Specific Capacity ___ gpm/ft.
11. Water Level: *est 152* ft. (rept.) *7/7 1976* above/below *(estimate from Mr. McCardle)* which is ___ ft. above/below surface.
___ ft. rept./meas. ___ 19 ___ above/below ______ which is ___ ft. above/below surface.
___ ft. rept./meas. ___ 19 ___ above/below ______ which is ___ ft. above/below surface.
___ ft. rept./meas. ___ 19 ___ above/below ______ which is ___ ft. above/below surface.
12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, ______
13. Quality: (Remarks on taste, odor, color, etc.)
Temp. *80* °F, Date sampled for analysis *7/7/76* Laboratory ______
Temp. ___ °F, Date sampled for analysis ______ Laboratory ______
Temp. ___ °F, Date sampled for analysis ______ Laboratory ______
14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log, Formation Samples, Pumping Test,
15. Record by: *R Rees & M. Munoz* Date *7/7* 19*76*
Source of Data *owner & obs.*
16. Remarks:
7/7/76 Currently drilling a 600' test hole. If looks good may complete in a year or so.

CASING & BLANK PIPE

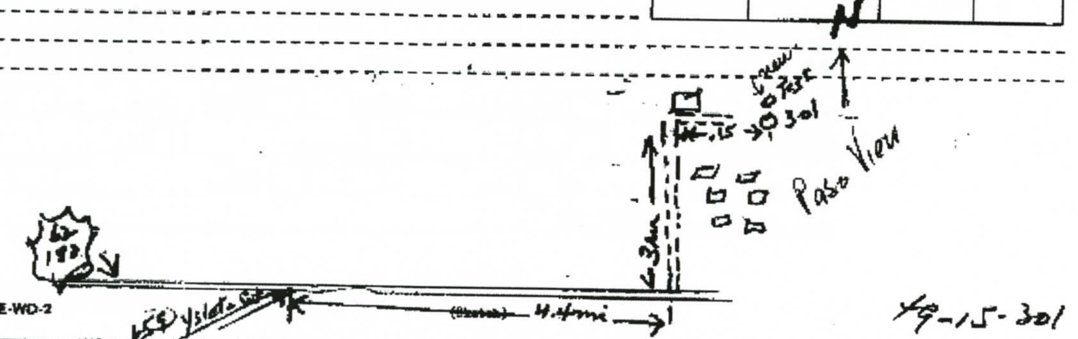
Cemented From ___ ft. to ___ ft.

Diam. (in.)	Type	Setting, ft. from	to
10 3/4		*0*	*558*

WELL SCREEN

Screen Openings ______

Diam. (in.)	Type	Setting, ft. from	to



TWDBE-WD-2 (Sketch)

49-15-301

ORIG

FORM 9-1642B (DEC. 68)

JL-49-15-303

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

MASTER CARD — OBS.

Record by: DECOURTIE — Source of data: D LOG — Date: 5/4/88 — Map: [illegible] SOUTH WELL 7 1/2 MIN

State: TEX — 48 — County (or town): EL PASO — JL

Latitude: 31 50 12 N — Longitude: 106 09 24 — Sequential number:

Lat-long accuracy: — Sec 21, NW, SW, SE, TSP2, SCH BLK G

Local well number: JL-49-15-303 — Other number:

Local use: — Owner or name: O.K. B [illegible] — MONTANA LD EST

Owner or name: MONTANA LD EST — (JOANN [illegible]) — Address: 1600 LEE TREVINO - SUITE C-2 EL PASO TX 79936

Ownership: County, Fed Gov't, City, Corp or Co (circled), Private, State Agency, Water Dist — N

Use of water: Air cond, Bottling, Comm, Dewater, Power, Fire, Dom, Irr, Med, Ind, P-S (circled), Rec, Stock, Instit, Unused, Repressure, Recharge, Desal-P S, Desal-other, Other

Use of well: Anode, Drain, Seismic, Heat Res, Obs, Oil-gas, Recharge, Test, Unused, Withdraw (circled), Waste, Destroyed

DATA AVAILABLE: Well data — Freq. W/L meas.: — Field aquifer char.

Hyd. lab. data:

Qual. water data: type: PROBIL TESTING NOV 1985 — 769 MG/L DS

Freq. sampling: 5/4/88 — Pumpage inventory: yes/no period:

Aperture cards: (FROM TAP ON DISCHG PIPE) — yes

Log data: D LOG 0-508'

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD — Depth well: 500 ft — 500 — Meas./rept. — accuracy

Depth cased (first perf.): 422 ft — 422 — Casing type: S — Diam. 10 in — 10

Finish: porous concrete, gravel w. (perf.), gravel w. (screen) (circled), horiz. gallery, open end, perf., screen (circled), sd. pt., shored, open hole, other — G

Method Drilled: air rot., bored, cable, dug, hyd rot. (circled), jetted, air percussion, reverse rotary, trenching, driven, drive wash, other — H

Date Drilled: 10/22/85 — 1085 — Pump intake setting: ft

Driller: COLE DRLG. CO. — 9516 GAIRLOCH EL PASO TX

Lift (type): air, bucket, cent, jet, multiple (cent.), multiple (turb.), none, piston, rot, submerg (circled), turb, other — Deep / Shallow

Power (type): diesel, elec (circled), nat gas, gasoline, hand, LP gas, wind; H.P. — Trans. or meter no.

Descrip. MP — ft above/below LSD, Alt. MP

Alt. LSD: 4080' ± — 4080 — Accuracy (source): 7 1/2 MIN, 5' CI

Water Level: 395 ft above/below MP; ft above/below (circled) LSD — 395 — Accuracy: REPT DRLR

Date meas.: 11/7/85 — Yield: 50 gpm — 50 — Method determined

Drawdown: 40 ft — 40 — Accuracy: REPT — Pumping period: 33 hrs — 33

QUALITY OF WATER DATA: Iron ppm — Sulfate ppm — Chloride ppm — Hard. ppm

Sp. Conduct 1334 k x 10⁶ — Temp. °F — Date sampled

Taste, color, etc. (NOV 85)

4080
-395
3685

49-15-303

9-135—July 1938
Revised

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES BRANCH

J2-49-15-601

WELL SCHEDULE

Date 3-16, 19 54 Field No. T-18
Record by JAC Office No. X-1
Source of data Test hole Log

1. Location: State Texas County El Paso
Map 31° 49' 22" N 106° 02' 01"
NW¼ SE¼ ¼ sec. 3 T 21 S N/S R T-2-S E/W
2. Owner: U.S. Geol. Survey Address
Tenant Address
Driller Edwards Drilling Co. of Texas Address
3. Topography
4. Elevation 4072.9 ft. above/below L.S.D.
5. Type: Dug, drilled, driven, bored, jetted 7 19 53
6. Depth: Rept. 1013 ft. Meas. ft.
7. Casing: Diam. 1 in., to in., Type
Depth ft., Finish
8. Chief Aquifer From ft. to ft.
Others
9. Water level 3911.4 ft. (rept./meas.) 7-19 19 53 above/below
Land surface which is ft. above/below surface
10. Pump: Type Non e Capacity G. M.
Power: Kind Horsepower
11. Yield: Flow G. M., Pump G. M., Meas., Rept. Est.
Drawdown ft. after hours pumping G. M.
12. Use: Dom., Stock, PS., RR., Ind., Irr., Obs. Test
Adequacy, permanence
13. Quality Temp °F.
Taste, odor, color Sample Yes/No
Unfit for
14. Remarks: (Log, Analyses, etc.) DST 475-495

Plugged Elec. + simple logs

49-15-601

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer _____ Field No. _____ State Well No. 49-15-602

Owner's Well No. X-12 County _____

1. Location NWCor. NW¼ Sec. 2 Block 78 Survey _____

2. Owner: J. Nava Address: Farmers Davies

Tenant: _____ Address: _____

Driller: _____ Address: _____

3. Elevation of 2SD is 4083 ft. above msl, determined by Top D.

4. Drilled: 1100 19__; Dug, Cable Tool, Rotary, _____

5. Depths: Repd. _____ ft. Meas. _____ ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed _____

7. Pump: Mfgr. _____ Type _____

No. Stages _____ Bowls Diam. _____ in., Setting _____ ft.

Column Diam. _____ in., Length Tailpipe _____ ft.

8. Motor: Fuel _____ Make & Model _____ HP. _____

9. Yield: Flow _____ gpm, Pump _____ gpm, Meas., Rept., Est. _____

10. Performance Test: Date _____ Length of Test _____ Made by _____

Static Level _____ ft. Pumping Level _____ ft. Drawdown _____ ft.

Production _____ gpm Specific Capacity _____ gpm/ft.

11. Water Level: _____ ft. rept. meas. 19__ above below which is _____ ft. above below surface.

_____ ft. rept. meas. 19__ above below which is _____ ft. above below surface.

_____ ft. rept. meas. 19__ above below which is _____ ft. above below surface.

_____ ft. rept. meas. 19__ above below which is _____ ft. above below surface.

12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, _____

13. Quality: (Remarks on taste, odor, color, etc.) _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

Temp. ___ °F, Date sampled for analysis _____ Laboratory _____

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log, Formation Samples, Pumping Test,

15. Record by J.R. Nunn Date 7-2 19 72

Source of Data USGS Schedule

16. Remarks: Pumping at 700'. OK for Cattle Not Potable - Salty.

CASING & BLANK PIPE

Cemented From _____ ft. to _____ ft.

Diam. (in.)	Type	Setting, ft. from	to

WELL SCREEN

Screen Openings

Diam. (in.)	Type	Setting, ft. from	to

TWDBE-WD-2 (Sketch)

49-15-602 ✓

FORM 9-1842B (DEC. 68)

Well No. JL-49-15-609

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

OWNER #0125

MASTER CARD

Record by DEWHITT Source of data DLOG Date 11/19/86 Map NATIONS SOUTH 7½

State TEX 48 County (or town) EL PASO JL

Latitude: 31 48 07 N Longitude: 106 09 21 W Sequential number: 1

Lat-long accuracy: T. S, R E, Sec 9, SW¼, NW¼, SW¼, ISR Z SURVEY

Local well number: JL-49-15-609 Other number:

Local use: Owner of name: HOMESTEAD MUD #2

Owner or name: HOMESTEAD MUD 2 Address: WELL #1

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist W

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Mnd, (N) Ind, (P) P-S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-F S, (Y) Desal-other, (Z) Other P

Use of well: (A) Anode, (D) Drain, (G) Geothermal, (H) Heat Rec, (O) Observ, (Q) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdrawal, (X) Waste, (Z) Destroyed W

DATA AVAILABLE: Well data Freq. W/L meas.: Field aquifer char.

Hyd. lab. data:

Qual. water data; type:

Freq. sampling: Pumpage inventory: yes no period:

Aperture cards: yes

Log data: DLOG 0-633'

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 633 ft 633 Meas. (ft) accuracy

Depth cased (first perf.) 470 ft 470 Casing type: S Diam. 12 in 12

Finish: (C) potous concrete, (E) gravel (perf.), (V) gravel (screen), (H) horiz. gallery, (O) open end, (P) perf., access, sd. pt., (S) shored, (T) tubular, (N) open hole, (B) other 6

Method Drilled: (A) air rac, (B) bored, (C) cable, (D) dug, (H) hyd jetted, (J) mix rot., (P) percussion, (R) reverse rotary, (K) crenching, (I) driven, (V) drive wash, (M) other 24" BOREHOLE 7

Date Drilled: 5/5/86 Pump intake setting: 504 ft 50

Driller: COLE DRLG CO, 9516 GARLOCK EL PASO TX (name, address)

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (B) other Deep Shallow

Power (type): diesel elec, gas, gasoline, hand, gas, wind; LP nat H.P. Treas. or water no.

Descrip. MP above below LSD, Alt. MP

Alt. LSD: 4073 4073 Accuracy: (source) ½ MAP

Water level 428 ft above below MP; Ft above below LSD 428 Accuracy: REST

Date meas: 6/17/86 Yield: 140 gpm 140 Method determined

Drawdown: 26 ft 26 Accuracy: REST Pumping period 48 hrs 48

QUALITY OF WATER DATA: Iron ppm Sulfate ppm Chloride ppm Hard. ppm

Sp. Conduct K x 10⁶ Temp. °F Date sampled

Taste, color, etc.

4073 − 428 = 3645

49-15-609

FORM 9-1642B
IDEC 681

Well No. JL-49-15-611

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

DAVE MACIAS

MASTER CARD

Record by DE WHITE. Source of data DRLG Date 3/11/87 Map NATIONS SOUTH

State TEX 42 County (or town) EL PASO 141

Latitude: 31 49 06 N/S Longitude: 106 05 55 Sequential number: 1

Lat-long accuracy: T. S, R. y, Sec. ¼, ¼, ¼ B & M

Local well number: JL-49-15-611 Other number:

Local use: Owner or name: JOE CONCRETE

Owner or name: JOE CONCRETE Address: 2275 AMERICAS AVE

Ownership: (C) County, (F) Fed Gov't, (M) City, (K) Corp or co., (P) Private, (S) State Agency, (U) Water Dist. EL PASO TX 79915

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Ind, (P) P S, (R) Rec. SUPPLIES QUARRY-CRUSHER

(S) Stock, (T) Test, (U) Unused, (W) Repressure, (X) Recharge, (Y) Desal-P S, (Z) Desal-other, Other

Use of wells: (A) Aband, (D) Drain, (E) Seismic, (H) Heat Res, (O) Obs, (O) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (Waste) Waste, (Destroyed) Destroyed ZN (4) HIS (5) R

DATA AVAILABLE: Well data Freq. W/L meas.: Field aquifer char.

Hyd. lab. data:

Qual. water data: type:

Freq. sampling: Purpose inventory: yes no; period:

Aperture cards: yes

Log data: DLOG 0-632'

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: 610 ft 610 Meas. type Accuracy

Depth cased (first perf.): 450 ft 450 Casing type: S Diam. 10¾ in 10

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open and, (P) perf., screen, (S) sd. pc., (T) shored, (U) open hole, (X) other

Method Drilled: (A) air rot., (B) hand, cable, (C) dug, (D) hyd rot., (J) jetted, (P) air percussion, rotary, (R) reverse rotary, (T) crenching, (V) driven, (W) drive wash, (X) other

Date Drilled: 1/23/86 9 8 6 Pump intake setting: 515 ft 515

Driller: COLE DRLG name 95C CHURCHILL EL PASO TX address

Lift (type): (A) air, (B) bucket, (C) cent., (J) jet, (L) multiple (cent.), (M) multiple (curb.), (P) rope, piston, (R) rot., (S) submers., (T) curb, (Z) other Deep Shallow

Power (type): diesel elec, nat gas, gasoline, hand, gas, wind; LP H2. Trans. or water no.

Descrip. MP ft above below LSD, Alt. MP

Alt. LSD: 4078 4078 Accuracy (source): T ½ MW

Water Level 398 ft above below MP; Ft above below LSD 398 Accuracy: REPORTED

Date meas: 1/23/86 1 86 Yield: 105 gpm 105 Method determined

Drawdown: 28 ft 028 Accuracy: REPT Pumping period 42 hrs 042

QUALITY OF WATER DATA: Iron ppm Sulfate ppm Chloride ppm Hard. ppm

Sp. Conduct K x 10⁵ Temp. °F Date sampled

Tests, color, etc.

4078
-398
3680'

49-15-611

Texas ... rtment of Water Resources
P. O. Box 13087
Austin, Texas 78711

State of Texas
WATER WELL REPORT

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

For TDWR use only
Well No. 49-15-6B
Located on map YES
Received: Rwg

1) OWNER John Barnett (Name) Address P.O.B. 26161 (Street or RFD) El Paso (City) Tx (State) 79926 (Zip)

2) LOCATION OF WELL:
County El Paso 12 miles in East (N.E., S.W., etc.) direction from El Paso (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description:
Section No. 22 Block No. 6 Township 2
Abstract No. _____ Survey Name T-P RR Co.
Distance and direction from two intersecting section or survey lines _____
☒ See attached map.

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☐ Public Supply ☐ Irrigation ☒ Test Well ☐ Other _____

5) DRILLING METHOD (Check):
☒ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other _____

6) WELL LOG:
Date drilled 9/1/81

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
10"	Surface	545'

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☐ Gravel Packed ☒ Other Covered up
If Gravel Packed give interval ... from _____ ft. to _____ ft.

From (ft.)	To (ft.)	Description and color of formation material
0	3	SAND - TAN
3	14	CALICHE - WHITE
14	41	CLAY - BRWN
41	56	SAND - TAN
56	160	CLAY - BRWN.
160	210	CLAY - ROSE
210	213	SANDSTONE - TAN
213	310	CLAY - BRWN
310	410	CLAY - ROSE
410	450	SANDY CLAY - BRWN.
450	545	CLAY - BRWN

SEP 03 1982
...R/TDWR

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
		NONE			

CEMENTING DATA
Cemented from _____ ft. to _____ ft.
Method used _____
Cemented by _____ (Company or Individual)

9) WATER LEVEL:
Static level NONE ft. below land surface Date _____
Artesian flow _____ gpm. Date _____

10) PACKERS: Type Depth

11) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

12) WELL TESTS:
☐ Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☒ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME Richard Lee Helms (Type or Print) Water Well Drillers Registration No. 2146

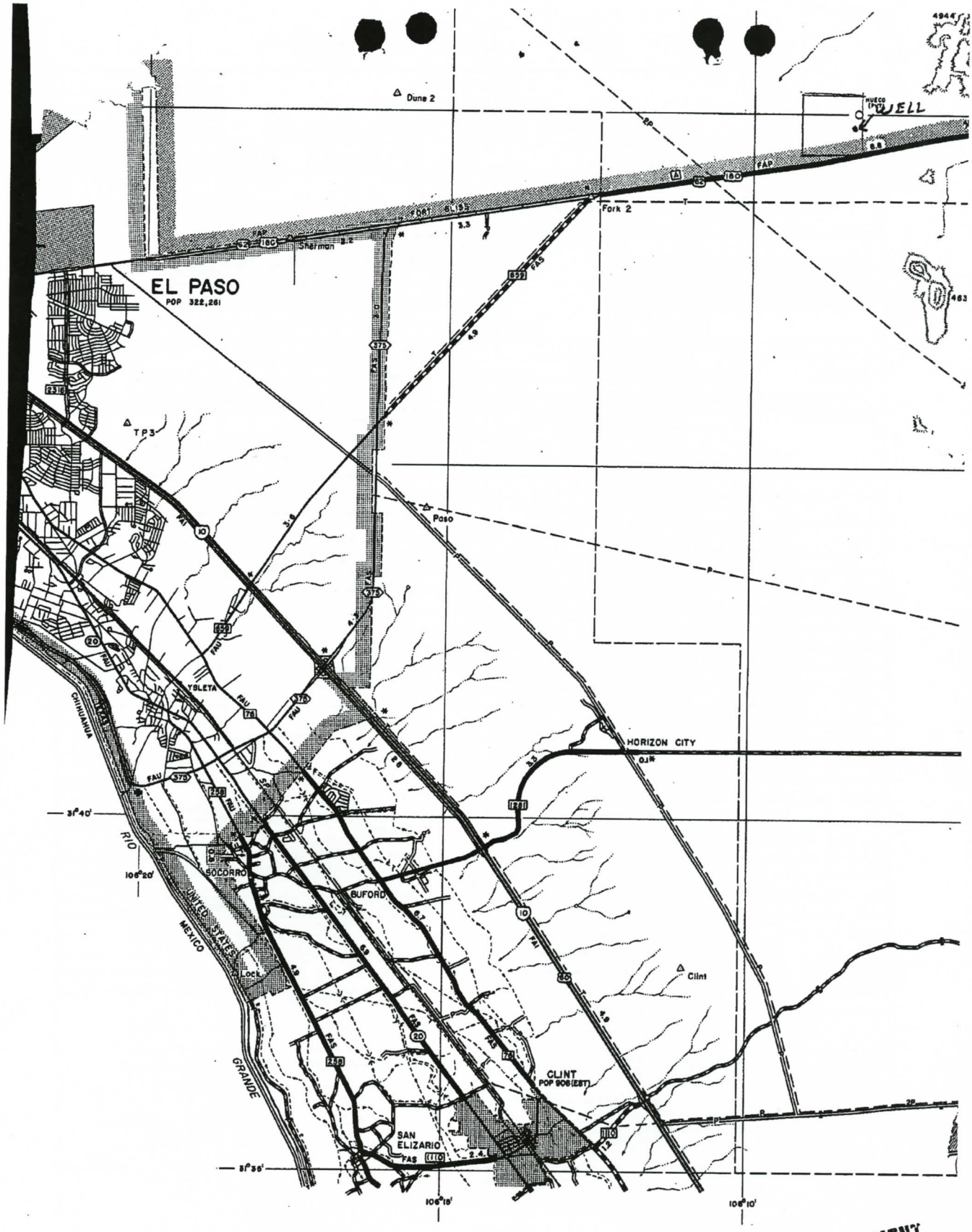
ADDRESS 14925 Montana (Street or RFD) El Paso (City) Tx (State) 79936 (Zip)

(Signed) _____ (Water Well Driller) The Montana Co (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TDWR-0392 (Rev. 1-12-79)

DEPARTMENT OF WATER RESOURCES COPY



ATTACHMENT
49-15-6B

Texas Water Development Board
Well Schedule

State Well No. 49 15 614 Previous Well No. County EL PASO 141
River Basin RIO GRANDE 23 Zone 1 Lat. 31 49 59 Long. 106 09 28 Source of Coord. 1
Owner's Well No. MCCRACKEN #2 Location ____ 1/4, ____ 1/4, Section ____, Block ____, Survey ____

Owner HOMESTEAD MUD Driller B & G DRILLING

Address ____ Tenant/Oper. ____

Date Drilled 11 13 1990 Depth 515 Source of Depth Datum D Alt. 4077 Source of Alt. Datum M
Aquifer HUECO BOLSON 118HCBL Well Type W Use 3 9 2 8 1 0

Well Construction: Const. Method MUD ROTARY H Casing Material STEEL S
Completion GRAVEL PACK G Screen Material GALVANIZED G
Lift Data: Pump Mfr. ____ Type SUBM S No. Stages ____
Bowls Diam. ____ in. Setting 460 FT ft. Column Diam. ____ in.
Motor Mfr. ____ Fuel or Power ELECT E Horsepower ____
Yield: Flow ____ GPM Pump 30 GPM Meas. Rep. Est. MEAS Date 11-13-90
Performance Test: Date 11-13-90 Length of Test 36 HRS Production ____ GPM
Static Level 400 ft. Pumping Level ____ ft. Drawdown ____ ft. Sp. Cap. ____ GPM/ft.
Quality / Remarks ____
Water Use: Primary PUBLIC P Secondary ____ Tertiary ____
Other Data Available: Water Level N Water Quality N Logs ____ Other Data ____
Water Levels: Date ____ Meas. ____ Date ____ Meas. ____ Date ____ Meas. ____

Casing or Blank Pipe (C) / Well Screen or Slotted Zone (S) / Open Hole (O) Cemented from 0 to 380

	Diam. Cml	Diam. Finish	Setting (feet) From	To
C	6		0	432
S	6	4	432	512
C	6	5	12	515

Recorded By BIRI Date Record Collected or Updated 07 28 1998 120 rmsl Reporting Agency 01

Remarks

Aquifer 118HCBL
Well No. 49-15-614

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer Test Hole | Field No. | Owner's Well No. TH #3 | State Well No. 49-15-904 | County El Paso

1. Location: 1/4, 1/4 Sec., Block, Survey El Paso Texas

2. Owner: EPWU TH #3 Address:
   Tenant: Address:
   Driller: Address:

3. Elevation of LSD is 4075 ft. above msl, determined by topo

4. Drilled: 7-23 19 68; Dug, Cable Tool, Rotary,

5. Depth: Rept. 531 ft. Meas. ft.

6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed

7. Pump: Mfgr. Type
   No. Stages, Bowls Diam. in., Setting ft.
   Column Diam. in., Length Tailpipe ft.

8. Motor: Fuel Make & Model HP,

9. Yield: Flow gpm, Pump gpm, Meas., Rept., Est.

10. Performance Test: Date Length of Test Made by
    Static Level ft. Pumping Level ft. Drawdown ft.
    Production gpm Specific Capacity gpm/Ft.

CASING & BLANK PIPE
Cemented From ft. to ft.

Diam. (in.)	Type	Setting, Ft. From	to

11. Water Level: ft. rept. meas. 19 above/below which is ft. above/below surface.
    ft. rept. meas. 19 above/below which is ft. above/below surface.
    ft. rept. meas. 19 above/below which is ft. above/below surface.
    ft. rept. meas. 19 above/below which is ft. above/below surface.

12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used, Test Hole

13. Quality: (Remarks on taste, odor, color, etc.)
    Temp. °F, Date sampled for analysis Laboratory
    Temp. °F, Date sampled for analysis Laboratory
    Temp. °F, Date sampled for analysis Laboratory

14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,
    Formation Samples, Pumping Test, File

15. Record by: Date 12-7 19 75
    Source of Data Layne Texas files

16. Remarks:

WELL SCREEN
Screen Openings

Diam. (in.)	Type	Setting, Ft. From	to

TWDBE-WD-2

See 49-15-702 (Sketch)

49-15-904

STATE OF TEXAS WELL REPORT for Tracking #72872

Owner:	**Jobe Materials,L.P.**	Owner Well #:	**5**
Address:	**1150 Southwest Drive El Paso , TX 79928**	Grid #:	**49-15-6**
Well Location:	**4300 Araceli El Paso , TX 79928**	Latitude:	**31° 49' 37" N**
Well County:	**El Paso**	Longitude:	**106° 07' 53" W**
Elevation:	**4160 ft.**	GPS Brand Used:	**Lowrance globalmap 100**
Type of Work:	**New Well**	Proposed Use:	**Industrial**

Drilling Date: Started: **10/20/2005**
Completed: **11/4/2005**

Diameter of Hole: Diameter: **23 in From Surface To 592 ft**

Drilling Method: **Mud Rotary**

Borehole Completion: Gravel Packed From: **20 ft to 592 ft**
Gravel Pack Size: **1/8**

Annular Seal Data: 1st Interval: **From 20 ft to 0 ft with 33 sacks cement (#sacks and material)**
2nd Interval: **No Data**
3rd Interval: **No Data**
Method Used: **tremmie**
Cemented By: **R.L. Guffey,Inc**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **482 ft. below land surface on 11/12/2005**
Artesian flow: **No Data**

Packers: **none**

Plugging Info: Casing left in well: From (ft) To (ft) Cement/Bentonite left in well: From (ft) To (ft) Cem/Bent Sacks Used
none

Type Of Pump: **Other: none**
Depth to pump bowl: **(No Data) ft**

Well Tests: **Pump**
Yield: **5 GPM with 105 ft drawdown after 1 hour**

Water Quality: Type of Water: **5000 tds (undesirable)**
Depth of Strata: **112 ft.**
Chemical Analysis Made: **No Data**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **Yes**
Naturally-occurring, poor-quality groundwater encountered.
Type: (No Data)

	The driller did certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner or person having the well drilled was informed that such well must be completed or plugged in a such a manner as to avoid injury or pollution.
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**R.L. Guffey, Inc. P.O. Box 756 Mesilla Park , NM 88047**
Driller License Number:	**4680**
Licensed Well Driller Signature:	**Padraic Guffey**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#72872**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-22 top soil, 22-37coarse sand, 37-59small gravel, 59-76 sandy clay, 76-85 sand, 85-97clay, 97-112 sandy clay, 112-189 clay with small gravel embedded, 189-240 sandyclay,240-250 clay, 250-268 sand, 268-315 sandyclay,315-333 sand, 333-339 sandyclay, 339-343 sand, 343-347 sandyclay, 347-432 sand with caliche streaks, 432-450 sandyclay, 450-461 sticky clay,461-477 sand with caliche streaks, 477-493 sandyclay, 493-499 sand, 499-507 clay, 507-529 sandyclay, 529-552 sand with caliche streaks,552-560 sandy clay, 560- 599 hard rock

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
12 3/4 new .375 blank steel casing +3-312
12 3/4 new .312 roscoe moss sutter 312-592 screen
12 3/4 new .375 bullnose plug 592-594

STATE OF TEXAS WELL REPORT for Tracking #89984

Owner:	**JOBE MATERIALS, L.P.**	Owner Well #:	**#5**
Address:	**1150 SOUTHVIEW DR EL PASO , TX 79928**	Grid #:	**49-15-6**
Well Location:	**4300 ARECELI EL PASO , TX 79928**	Latitude:	**31° 49' 23" N**
Well County:	**El Paso**	Longitude:	**106° 07' 32" W**
Elevation:	**No Data**	GPS Brand Used:	**MAGELLAN**
Type of Work:	**Deepening**	Proposed Use:	**Industrial**

Drilling Date: Started: **6/14/2006**
Completed: **6/20/2006**

Diameter of Hole: **No Data** Diameter: **10 in From 592 ft To 1100 ft**

Drilling Method: **Air Hammer**

Borehole Completion: **No Data**

Annular Seal Data: 1st Interval: **No Data**
2nd Interval: **No Data**
3rd Interval: **No Data**

Surface Completion: **No Data**

Water Level: Static level: **460 ft. below land surface on 6/20/2006**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **Submersible**
Depth to pump bowl: **840 ft**

Well Tests: **Pump**
Yield: **75 GPM with (No Data) ft drawdown after (No Data) hours**

Water Quality: Type of Water: **UNDESIRABLE 5000 TDS**
Depth of Strata: **855 ft.**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **Yes**
Naturally-occurring, poor-quality groundwater encountered.
Type: 5000 TDS
The driller did certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner or person having the well drilled was informed that such well must be completed or plugged in a such a manner as to avoid injury or pollution.

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information:	**SKINNER DRILLING** **PO BOX 544** **ALPINE , TX 79831**
Driller License Number:	**2838**
Licensed Well Driller Signature:	**WALTER SKINNER**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**BOREHOLE AND SURFACE WERE COMPLETED BY PRIOR DRILLER. REFER TO REPORT #72872.**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#89984**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
592 745 TAN LIMESTONE
745 825 TAN SANDSTONE
825 1050 RED GRANITE
1050 1100 BLACK METABASALT

CASING, BLANK PIPE & WELL SCREEN DATA

No Data

Send original copy by certified mail to the Texas Department of Water Resources P. O. Box 13087 Austin, Texas 78711

State of Texas
WATER WELL REPORT

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

For TDWR use only
Well No. 49-07-9A
Located on map Yes
Received: C.F.S.

1) OWNER E.W. McCRACKEN (Name) Address 8647 North Loop (Street or RFD) El Paso, Texas 79907 (City) (State) (Zip)

2) LOCATION OF WELL: County El Paso 15 miles in East (N.E., S.W., etc.) direction from El Paso Texas (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☒ Legal description:
Section No. 9 Block No. 6 Township Public School
Abstract No. 6671 Survey Name Grover Jones
Distance and direction from two intersecting section or survey lines one mile north of Montano Ave. on 5200, A Olshea Street. (we took)
☐ See attached map.

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☒ Domestic ☐ Industrial ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Other

5) DRILLING METHOD (Check):
☒ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other

6) WELL LOG:
Date drilled 7-6-83

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
12 1/4	Surface	~~315~~ 515

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 0 ft. to 515 ft.

From (ft.)	To (ft.)	Description and color of formation material
0	4	Grey sandy soil
4	26	white calche
26	30	white calche & gravel
30	33	red clay
33	83	grey course gravel
83	89	red clay
89	112	grey sand & gravel
112	115	red clay
115	139	grey course sand & gravel
139	143	brown clay
143	167	red clay
167	235	red sand
235	241	red clay
241	286	grey sand w/ clay stks.
286	297	red clay
297	315	hard red clay
315	425	grey sand w/ clay stks.
425	430	red clay
430	443	grey sand
443	447	red clay
447	481	grey sand
481	486	red clay
486	515	grey sand

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
6 5/8	N	Steel Blank	0	435	.219
6 5/8	N	Steel Milslot .080"X 3"X 24 slots per ft.	435	515	.250

CEMENTING DATA
Cemented from ft. to ft.
Method used
Cemented by (Company or Individual)

9) WATER LEVEL:
Static level 392 ft. below land surface Date 7-9-83
Artesian flow gpm. Date

PACKERS: Type Depth

11) TYPE PUMP:
☐ Turbine ☐ Jet ☒ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., 441 ft.

12) WELL TESTS:
☐ Type Test: ☒ Pump ☒ Bailer ☐ Jetted ☐ Estimated
Yield: 20 gpm with ft. drawdown after hrs.

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☒ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Good Depth of strata 425 - 515
Was a chemical analysis made? ☐ Yes ☒ No

RECEIVED
JUL 21 1983
DEPT. OF WATER RESOURCES

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME Pat Coles - Aqua Drilling Co. (Type or Print) Water Well Drillers Registration No. 1391

ADDRESS Rt 1 Box 677 (Street or RFD) Anthony (City) Texas - N.M. (State) 88021 (Zip)

(Signed) Pat Coles (Water Well Driller) AQUA DRILLING CO. (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TDWR-0392 (Rev. 1-12-79)

DEPARTMENT OF WATER RESOURCES COPY

Send original copy by certified mail to the Texas Department of Water Resources P. O. Box 13087 Austin, Texas 78711

State of Texas
WATER WELL REPORT

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

For TDWR use only
Well No. 49-07-98
Located on map. Yes DLF
Received:

1) OWNER Paso View Water Coop. (Name) Address 7000 O'Leary Rd. (Street or RFD) El Paso (City), Tx. (State) 79936 (Zip)

2) LOCATION OF WELL:
County El Paso, 18 miles in northeast (N.E., S.W., etc.) direction from El Paso (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description:
Section No. _____ Block No. _____ Township _____
Abstract No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____
☐ See attached map.

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☒ Public Supply ☐ Irrigation ☐ Test Well ☐ Other _____

5) DRILLING METHOD (Check):
☒ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other _____

6) WELL LOG:
Date drilled 7/1/84

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
15 3/4	Surface	545

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☐ Gravel Packed ☐ Other _____
If Gravel Packed give interval . . . from _____ ft. to _____ ft.

From (ft.)	To (ft.)	Description and color of formation material
0-3		top soil - red
3-36		caliche - white
36-39		sand gravel - tan
39-108		sand - tan
108-114		clay - rose
114 -252		sand tan
252-545		clay - rose

NO WATER

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
		NONE			

CEMENTING DATA
Cemented from _____ ft. to _____ ft.
Method used _____
Cemented by _____ (Company or Individual)

9) WATER LEVEL: NONE
Static level _____ ft. below land surface Date _____
Artesian flow _____ gpm. Date _____

10) PACKERS: Type Depth

11) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

12) WELL TESTS:
☐ Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

RECEIVED
AUG -8 1984
DEPT. OF WATER RESOURCES

(Use reverse side if necessary)

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☒ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME Richard Lee Helms (Type or Print) Water Well Drillers Registration No. 2146

ADDRESS 14925 Montana (Street or RFD) El Paso, Tx. (City) 79936 (State) (Zip)

(Signed) _____ (Water Well Driller) The Montana Co. (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TDWR-0392 (Rev. 1-12-79)

DEPARTMENT OF WATER RESOURCES COPY

49-07-9B

14mi S/NL
.5mi E/WL

Send original copy by certified mail to the Texas Department of Water Resources P. O. Box 13087 Austin, Texas 78711

State of Texas
WATER WELL REPORT

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

For TDWR use only: Well No. 49-15-3 Located on map Received:

1) OWNER Galindo Arcenio (Name) Address 14645 Simpson (Street or RFD) El Paso (City) Tx. (State) 79936 (Zip)

2) LOCATION OF WELL: County El Paso 5 miles in east (N.E., S.W., etc.) direction from El Paso (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description:
Section No. ____ Block No. ____ Township ____
Abstract No. ____ Survey Name ____
Distance and direction from two intersecting section or survey lines ____
☒ See attached map.

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Domestic ☐ Industrial ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Other ____

5) DRILLING METHOD (Check): ☒ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other ____

6) WELL LOG:

Date drilled March

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
14.75	Surface	500

7) BOREHOLE COMPLETION: ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other ____
If Gravel Packed give interval . . . from 320 ft. to 500 ft.

From (ft.)	To (ft.)	Description and color of formation material
0	5	Red Sand
5	20	Clay White
20	68	Sand + Gravel TAN
68	76	Clay Brown
76	135	Sand Brown
135	141	Clay Brown
141	238	Sand Tan
238	342	Clay Brown
342	396	Sand Tan
396	412	Clay Brown
412	421	Sand Brown
421	443	Clay Brown
443	473	Sand Tan
473	486	Clay Brown
486	496	Sand Tan
496	500	Clay Brown

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
6	N	steel			
6	N	perforated			

CEMENTING DATA
Cemented from surface ft. to 15 ft.
Method used poured
Cemented by The Montana Co. (Company or Individual)

9) WATER LEVEL:
Static level 340 ft. below land surface Date MAY 6, 86
Artesian flow ____ gpm. Date ____

10) PACKERS: Type Depth

11) TYPE PUMP:
☐ Turbine ☐ Jet ☒ Submersible ☐ Cylinder ☐ Other ____
Depth to pump bowls, cylinder, jet, etc., 420 ft.

12) WELL TESTS:
☐ Type Test: ☐ Pump ☒ Bailer ☐ Jetted ☐ Estimated
Yield: 5 gpm with 2 ft. drawdown after 3 hrs.

RECEIVED
MAY 30 1986
TEXAS WATER COMMISSION

(Use reverse side if necessary)

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☒ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME Richard Russ (Type or Print) Water Well Drillers Registration No. ____

ADDRESS ____ (Street or RFD) (City) (State) (Zip)

(Signed) ____ (Water Well Driller) (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TDWR-0392 (Rev. 1-12-79)

DEPARTMENT OF WATER RESOURCES COPY

STATE OF TEXAS WELL REPORT for Tracking #35818

Owner:	**El Paso Water Utilities**	Owner Well #:	**TW-3**
Address:	**1154 Hawkins Blvd.** **El Paso , TX 79961**	Grid #:	**49-08-1**
Well Location:	**McGregor Range** **El Paso , TX 79961**	Latitude:	**31° 59' 50" N**
Well County:	**El Paso**	Longitude:	**106° 06' 23" W**
Elevation:	**No Data**	GPS Brand Used:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Test Well**

Drilling Date: Started: **5/10/2003**
Completed: **7/28/2003**

Diameter of Hole: Diameter: **8 3/4 in From Surface To 39 ft**
Diameter: **6 1/4 in From 39 ft To 1075 ft**
Diameter: **5 1/8 in From 1075 ft To 2894 ft**

Drilling Method: **Mud Rotary**

Borehole Completion: **Open Hole**

Annular Seal Data: 1st Interval: **From 0 ft to 39 ft with 10 cement (#sacks and material)**
2nd Interval: **From 0 ft to 1075 ft with 114 cement (#sacks and material)**
3rd Interval: **No Data**
Method Used: **Pressure Grout**
Cemented By: **Stewart Brothers**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **n/a**
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information:	**Stewart Brothers** **P. O. Box 3891** **Milan , NM 87021**
Driller License Number:	**3175**
Licensed Well Driller Signature:	**William Brunson**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**$dfs**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#35818**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 90 Tan Sand
90 425 Clay Linterbald with Sand/ Silt
425 629 Conglomerate
629 710 Conglomerates w/Clays
710 900 Shale Drk to Blk
900 1280 Limestone with Shale
1280 1315 Igneow Intrusion
1315 2050 Limestone
2050 2230 Limestone Interbedded with Shale
2230 2894 Dolomite

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
7 New Steel 0 39 .375
5 9/16 New Steel 39 1075 .188

STATE OF TEXAS WELL REPORT for Tracking #63632

Owner:	**El Paso Water Utilities**	Owner Well #:	**Test Well #1**
Address:	**1154 Hawkins Blvd.** **El Paso , TX 79961**	Grid #:	**49-08-1**
Well Location:	**McGregor Range** **El Paso , TX 79961**	Latitude:	**31° 59' 20" N**
Well County:	**El Paso**	Longitude:	**106° 06' 45" W**
Elevation:	**No Data**	GPS Brand Used:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Test Well**

Drilling Date: Started: **3/10/2003**
Completed: **3/31/2003**

Diameter of Hole: Diameter: **8 3/4 in From Surface To 686 ft**
Diameter: **6 1/4 in From 686 ft To 2300 ft**

Drilling Method: **Mud Rotary**

Borehole Completion: **Open Hole**

Annular Seal Data: 1st Interval: **From 0 ft to 686 ft with 168 (#sacks and material)**
2nd Interval: **No Data**
3rd Interval: **No Data**
Method Used: **Pressure Grouted**
Cemented By: **Stewart Brothers Drilling**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No Data**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company **William Brunson**

Information:	**P. O. Box 2067 Milan , NM 87021**
Driller License Number:	**3175**
Licensed Well Driller Signature:	**William Brunson**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**$dfs**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 40 Med. to Fine Sand
40 90 Med. to Fine Sand with Gravel
90 110 Med. to Fine Light Brown
110 170 Sand Fine to Medium
170 210 Light Brown Sand
210 260 Clay
260 300 Clayey Silt
300 380 Silty Clay
380 490 Clayey Silt
490 690 Lost Circulation
690 1090 Limestone
1090 1340 Shaley Limestone
1340 1360 Siltstone
1360 1500 Shale
1500 1510 Limestone
1510 1580 Clay Stone
1580 1610 Shale
1610 1730 Limestone Interbeded
1730 2300 Limestone

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
7	**New**	**Steel**	**0 686**

STATE OF TEXAS WELL REPORT for Tracking #35834

Owner:	**El Paso Water Utilities**	Owner Well #:	**PH-01**
Address:	**1154 Hawkins Blvd.** **El Paso , TX 79961**	Grid #:	**49-08-1**
Well Location:	**McGregor Range** **El Paso , TX 79961**	Latitude:	**31° 59' 20" N**
Well County:	**El Paso**	Longitude:	**106° 06' 45" W**
Elevation:	**No Data**	GPS Brand Used:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Test Well**

Drilling Date: Started: **5/26/2003**
Completed: **8/6/2003**

Diameter of Hole: Diameter: **8 3/4 in From Surface To 575 ft**
Diameter: **6 1/4 in From 575 ft To 785 ft**

Drilling Method: **Mud Rotary**

Borehole Completion: **Open Hole**

Annular Seal Data: 1st Interval: **From 0 ft to 575 ft with 95 cement (#sacks and material)**
2nd Interval: **No Data**
3rd Interval: **No Data**
Method Used: **Pressure Grout**
Cemented By: **Stewart Brothers**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **n/a**
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company **Stewart Brothers**

Information:	**Box 3891** **Milan , NM 87021**
Driller License Number:	**3175**
Licensed Well Driller Signature:	**William Brunson**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**$dfs**

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Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 120 Reddish Sand/Silt
120 474 Reddish Clay with Silt
474 517 Siltstone
517 575 Conglomerate
575 785 Dark Blk to Gn. Shale

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
7	**New**	**Steel 0 575 .025**	

STATE OF TEXAS WELL REPORT for Tracking #63635

Owner:	**El Paso Water Utilities**	Owner Well #:	**Test Well #2**
Address:	**1154 Hawkins Blvd.** **El Paso , TX 79961**	Grid #:	**49-08-1**
Well Location:	**McGregor Range** **El Paso , TX 79961**	Latitude:	**31° 59' 14" N**
Well County:	**El Paso**	Longitude:	**106° 06' 32" W**
Elevation:	**No Data**	GPS Brand Used:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Test Well**

Drilling Date: Started: **4/9/2003**
Completed: **5/9/2003**

Diameter of Hole: Diameter: **8 3/4 in From Surface To 583 ft**
Diameter: **6 1/4 in From 583 ft To 972 ft**

Drilling Method: **Mud Rotary**

Borehole Completion: Other: **(No Data)**

Annular Seal Data: 1st Interval: **From 0 ft to 583 ft with 105 (#sacks and material)**
2nd Interval: **No Data**
3rd Interval: **No Data**
Method Used: **Pressure Grout**
Cemented By: **Stewart Brothers Drilling**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **K Packers 551'**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No Data**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company **William Brunson**

Information:	**P. O. Box 2067 Milan , NM 87021**
Driller License Number:	**3175**
Licensed Well Driller Signature:	**William Brunson**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**$dfs**

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Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 140 Sand Light Brown
140 320 Clay
320 390 Sand
390 430 Silty Sand
430 450 Conglomerate
450 460 Silty Sand
460 500 Conglomerate
500 510 Silt
510 850 Conglomerates
850 972 Bed Rock Limestone w/Shales

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
7 New Steel 0 583
4 1/2 New Steel 551 972 1/8"

Appendix F Dr. Anthony Tarquin Correspondence on Water/Wastewater Treatment Process

THE UNIVERSITY OF TEXAS AT EL PASO

February 21, 2010

Department of
Civil Engineering

Mr. Ben Knape
Underground Injection Control Permits Team
MC-233
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

RE: Treatment of Fusselman-Montoya-El Paso Group Water
El Paso Water Utilities
Proposed Aquifer Exemption for Class V Injection Wells
TCEQ Authorization No. 5X2700062, WWC No. 12124075, CN602957060/RN104809389

Dear Mr. Knape:

This letter is written as an attachment to the Aquifer Exemption Request for Class V Injection Wells that were drilled under Authorization No. 5X2700062. For the past eight years, I have been involved in research related to water recovery from silica-saturated reverse osmosis concentrate generated at the Kay Bailey Hutchison (KBH) desalting plant that is owned and operated by El Paso Water Utilities (EPWU). I was asked to render my opinion about the advisability of injecting their RO concentrate into the Fusselman-Montoya-El Paso Group. This letter is in response to that request.

It is my understanding that the current Class V injection authorization prohibits injecting water that does not meet primary drinking water standards. A summary of concentrate water quality provided to me by EPWU indicates that the concentrate from the KBH plant exceeds the water quality standard of 10 ppb for arsenic. However, the groundwater at the injection site also exceeds the 10 ppb water quality standard for arsenic. Furthermore, the groundwater exceeds the drinking water standard for several other water quality parameters, including TDS, nitrite, gross alpha, and radium. Thus, in order for that groundwater to serve as a future source of drinking water supply, it would have to be subjected to rigorous treatment to remove the contaminants that are already there, including arsenic. Therefore, it appears to me that the injection of the concentrate from the KBH plant will not render the groundwater either less treatable or more costly to treat than it already is (in fact, it might do the reverse through dilution). In any case, I would be glad to discuss this matter with you if you so desire. You can call me at work at (915) 747-6915 or on my cell phone at (915) 667-1155.

Sincerely,

Anthony J. Tarquin

Anthony Tarquin, Ph.D.
Professor – Civil Engineering/Science Engineering
The University of Texas at El Paso

AACE
Alumni Academy
of Civil Engineers

500W. University Ave.
El Paso, Texas
79968-0516
(915) 747-5464
FAX: (915) 747-8037

Anthony Tarquin, Ph.D.

Professor-Civil Engineering
Engineering/Science Complex
Engineering Bldg., Room A220
atarquin@utep.edu
(915)747-6915

Dr. Tarquin's main area of research is Environmental Engineering, while still involved in: Economic Optimization of Water/Wastewater treatment processes, Water conservation/wastewater recycling, Water/Wastewater desalting.

Dr. Anthony Tarquin has completed numerous research projects related to industrial wastewater treatment, domestic wastewater treatment, and small waste flows. Recently, Tarquin's projects have dealt with brackish water desalting and volume reduction of silica-saturated RO concentrates. These projects focus on the concern of water resources in arid environments, optimizing conservation, and any associated economic matters. In the past, Tarquin has studied methods of teaching to help improve the way students learn.

Located at The University of Texas at El Paso, the **Center for Inland Desalination Systems (CIDS)** is a newly formed center that is studying desalination-related issues as:

- mining the brine concentrate produced during the Reverse Osmosis (RO) process
- developing small-scale portable desalination equipment to be used in remote locations
- developing processes that maximize energy and water production efficiencies

CIDS builds on a strong foundation of related research already being done by faculty members in geological sciences, chemistry and civil engineering. CIDS funding is currently a combination of a $2 million grant from the state of Texas through its Emerging Technology Fund, $2 million from The University of Texas System, and matching funds raised by UTEP (goal is $2 million in sponsored research from industry partners).

Above: One of three portable equipment "skids" available for research. Pictured here is the electrodialysis-metathesis (EDM) portion of the Zero Discharge Desalination (ZDD) technology, invented by Dr. Tom Davis. EDM technology is added to a reverse osmosis system for highly efficient desalination, improving efficiencies from 75% to more than 90%.

CIDS has several regional partners, including the El Paso Water Utilities Public Service Board, which manages the largest inland desalination facility in the United States. The 27.5 million gallon per day desalination facility is a partnership between the city of El Paso and the Fort Bliss army base. The five-year agreement approved by the Board includes creation of a Center for Excellence in research, education and outreach related to water resource management and inland desalination. Other partnerships include the Consortium for Hi-Technology Investigations in Water and Waste Water (CHIWAWA) and Veolia Water Solutions and Technologies.

Current research direction at CIDS include seawater pilot demonstrations in Libya and highly efficient brackish desalination pilot demonstrations and research in New Mexico, California, Texas, and Florida. CIDS plans to research technologies and approaches that will maximize the benefits of desalination, while minimizing the input energy and negative environmental impacts.

CIDS is in the process of developing an extensive website. For further information, contact:

Center for Inland Desalination Systems
500 West University Ave
Burges Hall, Room 216
El Paso, TX 79902
Phone: (915) 747-5328
CIDS@utep.edu